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U.S. Department of Energy
Idaho Operations Office

ICDF Complex Groundwater Monitoring Plan

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Prepared for the
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ABSTRACT

This Groundwater Monitoring Plan, along with the *Quality Assurance Project Plan for Waste Area Group 1, 2, 3, 4, 5, 6, 7, 10, and Inactive Sites*, constitutes the sampling and analysis plan for groundwater and perched water monitoring at the INEEL CERCLA Disposal Facility (ICDF) Complex. A detection monitoring system was installed in the Snake River Plain Aquifer to comply with substantive requirements of "Releases from Solid Waste Management Units" (40 CFR 264, Subpart F) of the Resource Conservation and Recovery Act. Five new downgradient monitoring wells were constructed in the aquifer. These wells and an existing upgradient well are being used for detection monitoring. Six new perched-water wells, with a maximum of three completions in each borehole, also were installed. To establish background contaminant concentrations, four samples were collected from the Snake River Plain Aquifer monitoring wells and the three locations where perched water was found before startup of the ICDF Complex operations in September 2003.

The perched water discovered was a remnant from the former Idaho Nuclear Technology and Engineering Center percolation ponds, and the perched water is draining. The Agencies agreed that the perched water would not be added to the detection-monitoring network at this time, but that perched water levels will be monitored. Perched water will be sampled only if a change in the trend of perched water levels occurs. Once perched water monitoring wells go dry, they will not be deepened or replaced. Additional baseline samples are being collected due to concerns over the original placement of pumps in the downgradient aquifer wells. In addition, C-14 has been added to the baseline sampling. The frequency of sampling for indicator parameters under the detection-monitoring program has been increased from semiannually to quarterly for the first year beginning in June 2003 and will be semiannually thereafter. Once every 2-1/2 years, samples will be collected from the detection-monitoring wells for a more comprehensive list of analytes. This revision of the Groundwater Monitoring Plan incorporates changes necessary to address the additional sampling and to remove leachate and evaporation pond sampling, which is not part of groundwater detection monitoring and is covered in the *ICDF Complex Operational and Monitoring Sampling and Analysis Plan.* Work done to date is covered in Revision 0 of this document and subsequent aquifer and perched water reports. Data from ICDF wells, leachate, and the ponds—along with water level data and data from existing wells—will be used as lines of evidence to determine whether a release occurs from the ICDF landfill or evaporation ponds.

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FIGURES

TABLES

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ACRONYMS

ALS	alpha spectrometry
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
BIC	Balance of INEEL Cleanup
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ES&H	environmental, safety, and health
FFA/CO	Federal Facility Agreement and Consent Order
FTL	field team leader
GDE	guide
GFP	gas flow proportional
GMS	gamma screen
HASP	health and safety plan
HDPE	high-density polyethylene
HSO	health and safety officer
ICDF	INEEL CERCLA Disposal Facility
ICPP	Idaho Chemical Processing Plant
ID	identification
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IEDMS	Integrated Environmental Data Management System
INEEL	Idaho National Engineering and Environmental Laboratory

INTEC	Idaho Nuclear Technology and Engineering Center
K_d	distribution coefficient [L^3/m]
LEPS	low-energy photon spectrometry
LSC	liquid scintillation counting
LSS	liquid scintillation spectrometry
MCL	maximum contaminant level
NE-ID	U.S. Department of Energy Idaho Operations Office
OU	operable unit
QA	quality assurance
QC	quality control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI/BRA	remedial investigation/baseline risk assessment
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
SAP	sampling and analysis plan
SLDRS	secondary leak detection and recovery system
SRPA	Snake River Plain Aquifer
SVOC	semivolatile organic compound
TEGD	Technical Enforcement Guidance Document
USC	United States Code
USGS	U.S. Geological Survey
VOC	volatile organic compound
WAG	waste area group

ICDF Complex Groundwater Monitoring Plan

1. INTRODUCTION

The U.S. Department of Energy Idaho Operations Office (NE-ID),[a] the U.S. Environmental Protection Agency (EPA), and the Idaho Department of Environmental Quality (IDEQ) (collectively referred to as the Agencies) authorized a remedial design/remedial action for the Idaho Nuclear Technology and Engineering Center (INTEC) in accordance with the *Final Record of Decision Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13* (DOE-ID 1999). The Record of Decision (ROD) requires Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 USC § 9601 et seq.) remediation waste generated at the Idaho National Engineering and Environmental Laboratory (INEEL) to be removed and disposed of on-Site in the INEEL CERCLA Disposal Facility (ICDF) Complex. Other INEEL CERCLA waste can be managed and disposed of at the ICDF Complex in accordance with other RODs. The ICDF Complex, located south of INTEC (Figures 1-1 and 1-2), is an on-Site, engineered facility meeting the substantive requirements of U.S. Department of Energy (DOE) Order 435.1, "Radioactive Waste Management"; Resource Conservation and Recovery Act (RCRA) Subtitle C (42 USC § 6901 et seq.); the Idaho Hazardous Waste Management Act (Idaho Code § 39-4401 et seq.); the Toxic Substances Control Act (15 USC § 2601 et seq.); and polychlorinated biphenyl landfill design and construction requirements. The ICDF Complex includes the necessary subsystems and support facilities to provide a complete waste management and disposal system.

The major components of the ICDF Complex are the landfill disposal cells, two evaporation ponds, and the Staging, Storage, Sizing, and Treatment Facility. The disposal cells, including a buffer zone, cover approximately 40 acres, with a disposal capacity of about 510,000 yd^3. The capacity of the evaporation ponds is 2.2 million gal each. The Staging, Storage, Sizing, and Treatment Facility is designed to provide centralized receipt, inspection, and treatment necessary to stage, store, and treat incoming waste from various INEEL CERCLA remediation sites before disposal in the ICDF landfill or evaporation ponds or shipment off-Site. All ICDF Complex activities will take place within the Waste Area Group (WAG) 3 area of contamination to allow flexibility in managing the consolidation and remediation of waste without triggering land disposal restrictions and other RCRA requirements, in accordance with the Operable Unit (OU) 3-13 ROD (DOE-ID 1999). Only low-level, hazardous, mixed, and limited quantities of Toxic Substances Control Act waste will be treated and/or disposed of at the ICDF Complex. Most of the waste will be contaminated soil, but debris and investigation-derived waste also will be included in the waste inventory. The ICDF landfill leachate, decontamination water, and water from INEEL CERCLA-related well drilling, purging, sampling, and well development and maintenance activities will be disposed of in the ICDF evaporation pond.

Only INEEL on-Site CERCLA waste meeting the appropriate Agency-approved waste acceptance criteria will be accepted at the ICDF Complex. Treatability testing can be used to determine if the waste can be treated to meet the waste acceptance criteria. An important objective of the waste acceptance criteria is to ensure that hazardous substances disposed of in the ICDF landfill and evaporation ponds will not result in exceeding the groundwater quality standards in the underlying Snake River Plain Aquifer (SRPA). The waste acceptance criteria include restrictions on contaminant concentrations based on groundwater modeling results, with the goal of preventing potential future maximum contaminant levels (MCLs) to be exceeded in the SRPA from ICDF Complex operations and disposal.

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a. The abbreviation NE-ID signifies that the U.S. Department of Energy Idaho Operations Office (which was abbreviated DOE-ID before October 1, 2003) reports to the U.S. Department of Energy Office of Nuclear Energy, Science, and Technology.

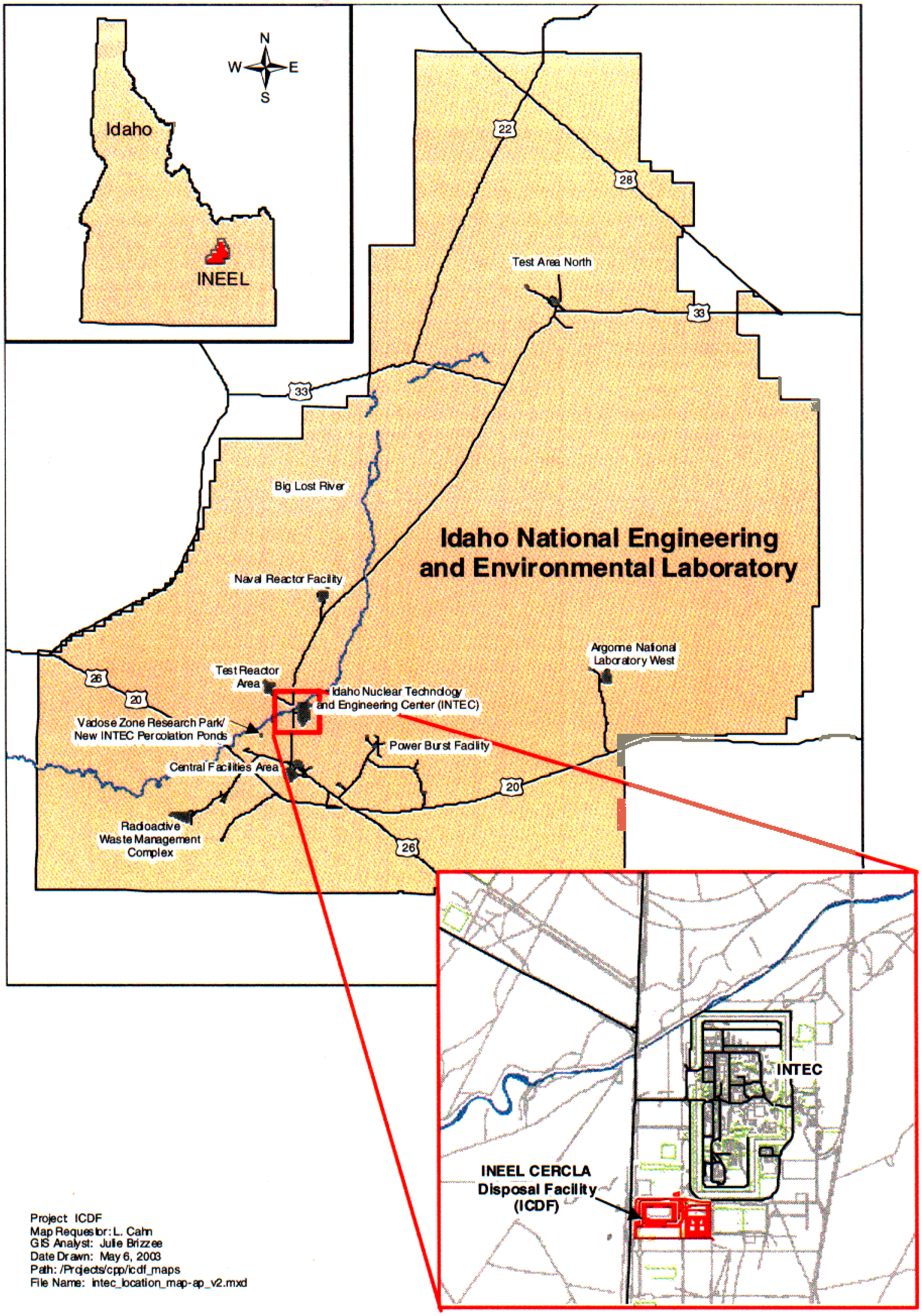

Figure 1-1. Location of the ICDF on the Idaho National Engineering and Environmental Laboratory.

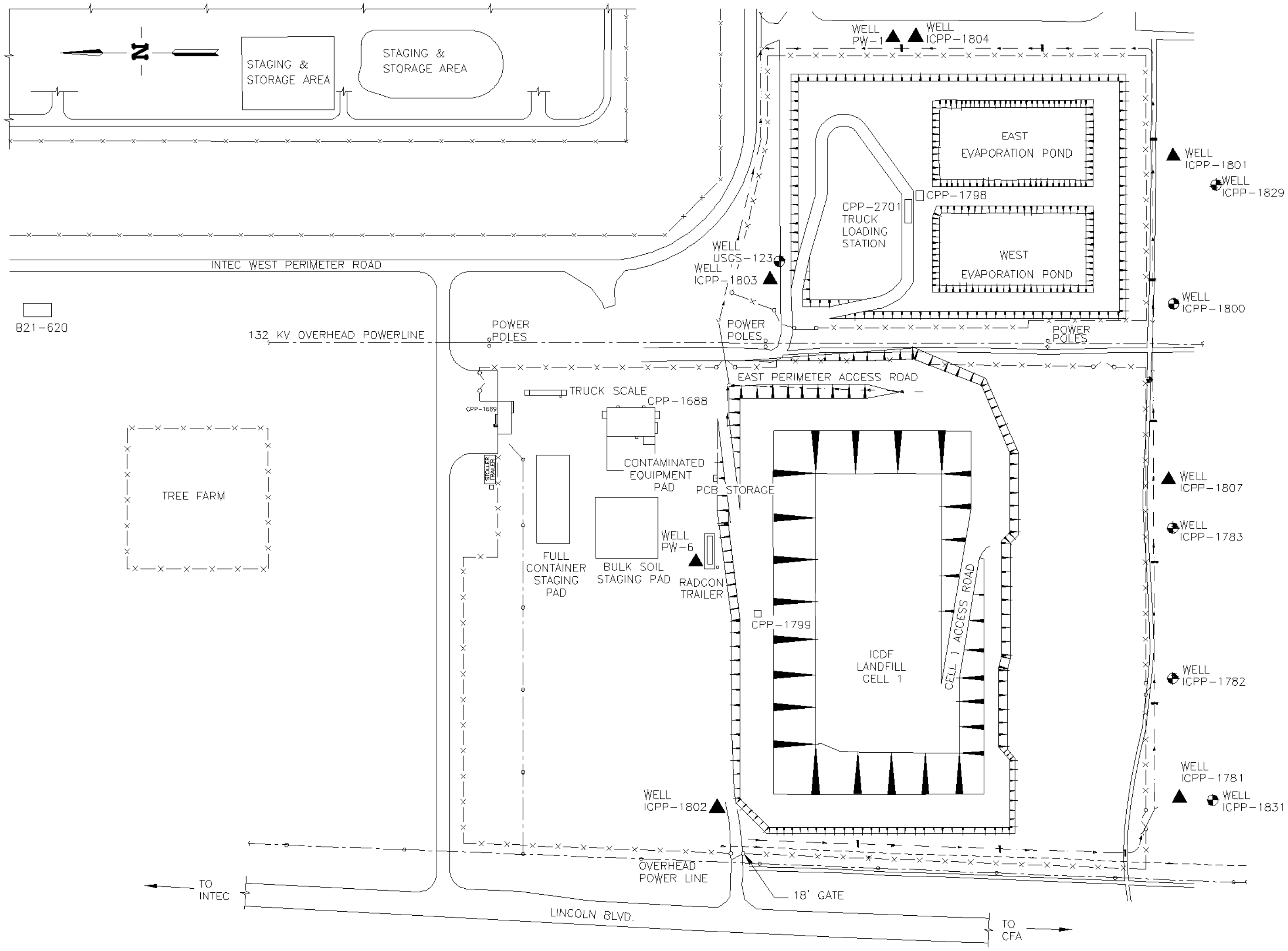

Figure 1-2. The ICDF complex layout and well locations. (Note: Circles are detection monitoring wells and triangles are perched water wells.)

1.1 Regulatory Requirements

The OU 3-13 ROD (DOE-ID 1999) is very specific on which sections of 40 *Code of Federal Regulations* (CFR) 264, Subpart F, "Releases from Solid Waste Management Units," are applicable or relevant and appropriate requirements (ARARs) for the ICDF Complex. The ARARs are listed in Table 1-1 and discussed individually to clarify when and how they apply to the groundwater monitoring system. Note that only the substantive requirements of the ARARs need to be met.

Table 1-1. The ICDF Complex groundwater monitoring applicable or relevant and appropriate requirements.

ARAR	Description
IDAPA 16.01.05.008[a] (40 CFR 264.92)	Groundwater protection standard
IDAPA 16.01.05.008[a] (40 CFR 264.93)	Hazardous constituents
IDAPA 16.01.05.008[a] (40 CFR 264.95)	Point of compliance
IDAPA 16.01.05.008[a] (40 CFR 264.97)	General groundwater monitoring requirements
IDAPA 16.01.05.008[a] (40 CFR 264.98)	Detection monitoring program

a. The IDAPA 16 citations have been changed to IDAPA 58.
ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
IDAPA = Idaho Administrative Procedures Act

The groundwater protection standard is found in 40 CFR 264.92, "Ground-water Protection Standard," and requires that:

> …hazardous constituents under §264.93 detected in the groundwater from a regulated unit do not exceed the concentration limits under §264.94 in the uppermost aquifer underlying the waste management area beyond the point of compliance.

However, 40 CFR 264.94, "Concentration Limits," is not an ARAR, and the standard that was set in the OU 3-13 ROD (DOE-ID 1999) is to prevent the release of leachate to underlying groundwater, which would result in exceeding MCLs, a cumulative carcinogenic risk of 1×10^{-4}, or a hazard index of 1 in the SRPA. In 40 CFR 264.97, the major components required for construction of the monitoring system are outlined, and this groundwater monitoring plan outlines the ICDF Complex compliance with those requirements. Since the ICDF Complex is a new unit and a leak cannot have occurred from a unit under construction, the ARAR for the monitoring system is 40 CFR 264.98, "Detection Monitoring Program." If a leak from the unit occurs, then compliance monitoring will be implemented as outlined later in this Groundwater Monitoring Plan.

1.1.1 General Monitoring Requirements

The applicable general monitoring requirements are found in 40 CFR 264.97. As allowed under 40 CFR 264.97(b), the groundwater monitoring system installed for the ICDF Complex was designed for the landfill and the evaporation pond as a single, regulated unit. Because the landfill and evaporation ponds have leak detection systems and the monitoring system will enable detection and measurement at the point of compliance in the uppermost aquifer, a single monitoring system is adequate. The point of compliance for this facility is the area described by an imaginary line circumscribing the ICDF landfill and evaporation ponds (40 CFR 264.95), and 40 CFR 264.97(a) states: "The groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths to yield ground-water samples from the uppermost aquifer." The ICDF Complex includes one upgradient and five downgradient wells completed in the upper portion of the SRPA (discussed in Section 3). The downgradient wells are newly installed wells that meet the substantive requirements of the *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD)* (EPA 1986). The selected upgradient well is U.S. Geological Survey (USGS) -123, which already exists. Six new perched-water monitoring wells were installed with a maximum of three completions in each borehole, but are not part of the detection monitoring system at this time because the perched water, which is a remnant of the former INTEC percolation ponds, is draining.

The groundwater monitoring program for sampling and analytical methods is discussed in Sections 3 and 4 of this plan. The monitoring program will include a determination of water levels each time groundwater is sampled. The monitoring program will include a sequence of baseline samples taken from the SRPA before startup and additional samples from the downgradient wells during the first year of operation. The background water quality will be different from uncontaminated concentrations upgradient of INEEL facilities. Because the existing groundwater is contaminated, the baseline water quality will be considered background for the purposes of the substantive RCRA requirements.

This sampling plan is based on historical information and evaluations of the effective porosity, hydraulic conductivity, gradient, and fate and transport of the potential contaminants. During operations, sampling will occur semiannually for indicator parameters, and once every 2-1/2 years for a larger list of analytes.

The method for determining a leak from the unit will fulfill all the requirements outlined in 40 CFR 264.97(1). This methodology is discussed in the *ICDF Complex Operational and Monitoring Sampling and Analysis Plan* (DOE-ID 2003a). All groundwater data will be maintained in the facility operating record for the period outlined in Section XX of the *Federal Facility Agreement and Consent Order for the Idaho National Engineering and Environmental Laboratory* (DOE-ID 1991). These data will be maintained in a format that allows for determination of a significant difference between upgradient and downgradient water quality.

1.1.2 Detection Monitoring Program

Until such time as statistically significant evidence demonstrates a release from the ICDF Complex, detection monitoring will be conducted at the ICDF Complex as allowed by 40 CFR 264.98. The indicator parameters that are relevant for, and allowed under, 40 CFR 264.98(a) are listed in Sections 3 and 4 of this plan. In developing these indicator parameters, the following factors were considered:

- The types, quantities, and concentrations of constituents managed within the ICDF Complex

- The mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the waste management unit

- The detectability of indicator parameters, waste constituents, and reaction products

- The concentrations or values and coefficients of variations of proposed monitoring parameters or concentrations in the background groundwater.

The downgradient wells, which are discussed further in Section 4.1.1, were installed just beyond the downgradient edge of the southern ICDF landfill cell (#2) and the evaporation ponds.

1.1.3 Statistically Significant Evidence of Contamination

If evidence of increased contamination in the perched water or SRPA is determined based upon evaluation of detection monitoring data, then the Agencies will be notified in accordance with Section XIX of the Federal Facility Agreement and Consent Order (FFA/CO) (DOE-ID 1991). The notification will indicate which chemical parameters or hazardous waste detections are statistically significant. Details of the statistical analysis of data are provided in the *INEEL CERCLA Disposal Facility Groundwater Detection Monitoring Program: Data Analysis Plan* (DOE-ID 2003b).

1.2 Objectives and Scope

The objectives of this Groundwater Monitoring Plan are to provide for well drilling, installation, and maintenance and sample collection, analysis, and interpretation required to meet ARARs, remedial action objectives (RAOs), and remediation goals established in the OU 3-13 ROD (DOE-ID 1999) for groundwater monitoring at the ICDF Complex. The OU 3-13 ROD's RAOs for groundwater require NE-ID to "maintain caps placed over…the closed ICDF-complex, to prevent the release of leachate to underlying groundwater which would result in exceeding a cumulative carcinogenic risk of 1×10^{-4}, a total HI [hazard index] of 1; or applicable State of Idaho groundwater quality standards (i.e., MCLs) in the SRPA." The basic objective of the groundwater monitoring is to determine if a release of contaminants has occurred from the ICDF landfill cells or evaporation ponds and whether it would adversely affect the water quality in the SRPA.

The scope of this groundwater monitoring plan is for replacement of aquifer wells (as necessary), long-term collection and analysis of water samples from the SRPA, and from perched water beneath the ICDF Complex if there is a change in trend for perched water levels. Samples collected from the leachate collection and recovery system sump, the primary and secondary leak detection and recovery systems, the evaporation ponds, and the pump station are covered under a separate plan (DOE-ID 2003a). These samples will allow for "fingerprinting" of the leachate and comparing water samples collected from the secondary leak detection and recovery system to actual landfill leachate. Leachate sampling also will allow for periodic evaluation and updating of the list of indicator analytes. The SRPA groundwater samples will be collected from a detection-monitoring network located upgradient and downgradient of the ICDF Complex. Sampling of the SRPA will use one existing monitoring well upgradient of the ICDF Complex and five new monitoring wells constructed downgradient of the landfill. Baseline SRPA samples will be collected before startup of the ICDF Complex operations and during the first year of operation. Indicator parameters will be monitored on a quarterly basis (which began in June 2003) and semiannually (which will begin in June 2004), and a larger list of analytes will be monitored every 2-1/2 years throughout operations and closure of the ICDF Complex in 2048. Following closure of the ICDF Complex landfill and evaporation ponds, monitoring will continue in order to meet the RAOs established in the OU 3-13 ROD (DOE-ID 1999).

2. SITE DESCRIPTION AND BACKGROUND

Both a remedial investigation/feasibility study (RI/FS) (DOE-ID 1997a, 1997b, and 1998) and a ROD (DOE-ID 1999) have been completed for the ICDF Complex site at INTEC. With a completed RI/FS and ROD, significant site characterization work (including site geology, hydrology, and nature and extent of contamination) has been conducted for the subsurface at the new ICDF Complex (DOE-ID 2000; Cahn, Meachum, and Leecaster 2003).[b] In addition, monitoring of the unsaturated zone and SRPA is underway at INTEC as part of the WAG 3 Group 4 perched water and Group 5 SRPA remedial actions (DOE-ID 2003a, 2003c, and 2003d).

2.1 Site Background

The INEEL is a government-owned facility managed by the NE-ID. The eastern boundary of the INEEL is located 32 mi west of Idaho Falls, Idaho. The INEEL Site occupies approximately 890 mi^2 of the northwestern portion of the eastern Snake River Plain in southeast Idaho. The INTEC facility covers an area of approximately 0.15 mi^2 and is located approximately 45 mi from Idaho Falls, Idaho, in the south-central area of the INEEL, as shown in Figure 1-1. The ICDF Complex is adjacent to the southwest corner of the INTEC facility.

The INTEC facility has been in operation since 1952. Its original mission was to reprocess uranium from defense-related projects and to research and store spent nuclear fuel. The DOE phased out the reprocessing operations in 1992 and redirected the INTEC mission to (1) receipt and temporary storage of spent nuclear fuel and other radioactive waste for future disposition, (2) management of current and past waste, and (3) performance of remedial actions.

The liquid waste generated from past reprocessing of spent nuclear fuel was stored in an underground tank farm. The INTEC tank farm consists of eleven 300,000-gal tanks, four 30,000-gal tanks, and associated equipment for the monitoring and control of waste transfers and tank parameters. One of the 300,000-gal tanks is empty and serves as a spare tank in the event of an emergency. Raffinates generated during the first-, second-, and third-cycle fuel extraction processes comprised the majority of waste stored in the tank farm.

Numerous CERCLA sites are located in the area of the tank farm and adjacent to the process equipment waste evaporator. Contaminants found in the interstitial soils of the tank farm are the result of accidental releases and leaks from process piping, valve boxes, and sumps and are the result of cross-contamination from operations and maintenance excavations. No evidence has been found to indicate that the actual waste tanks have leaked. The contaminated soils at the tank farm make up about 95% of the known contaminant inventory at INTEC. The final comprehensive RI/FS for OU 3-13 (DOE-ID 1997a, 1997b, and 1998) contains a discussion of the nature and extent of contamination.

The contamination in the SRPA originated primarily from the former injection well (shown on Figure 2-1). However, contaminated soils and perched water were predicted from modeling during the OU 3-13 remedial investigation/baseline risk assessment (RI/BRA) to contribute to future SRPA contamination if sites were not remediated (DOE-ID 1997a). The iodine-129 (I-129), strontium-90 (Sr-90), and plutonium isotopes were determined to be the only contaminants that could pose an unacceptable risk to a hypothetical future resident beyond the year 2095. The primary I-129 source was the former injection well. The primary Sr-90 sources were the former injection well and the tank farm soils. The primary source of plutonium isotopes is the tank farm. The major human health threat posed by contaminated SRPA groundwater is exposure to radionuclides via ingestion by future groundwater users.

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b. Cahn, Lorie and Shannon L. Ansley, 2004, "Analysis of Perched Water Data from ICDF Monitoring Wells (Draft)," INEEL/EXT-03-00250, Idaho National Engineering and Environmental Laboratory, March 2004.

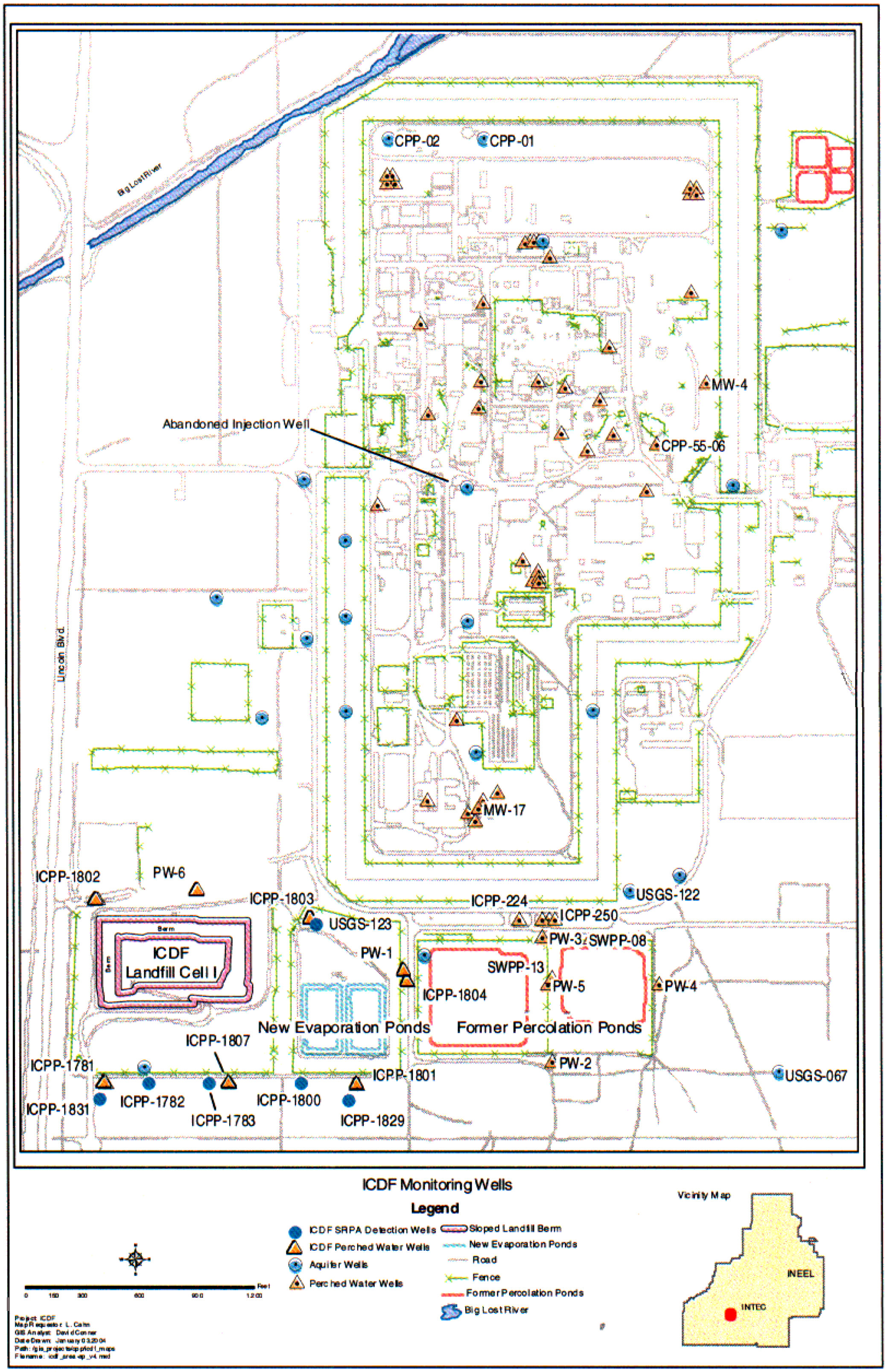

Figure 2-1. Locations of wells including abandoned injection well and ICDF wells.

2.2 Site Conceptual Model

The conceptual model that controls flow and transport beneath the ICDF Complex is summarized in this section. For a more complete description, refer to the following documents:

- *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)* (DOE-ID 1997a)
- *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part B, FS Report (Final)* (DOE-ID 1997b)
- *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part B, FS Supplement Report* (DOE-ID 1998)
- *ICDF Complex Groundwater Monitoring Plan* (DOE-ID 2002b)
- *Phase I Monitoring Well and Tracer Study Report for Operable Unit 3-13, Group 4, Perched Water* (DOE-ID 2003d)
- "Analysis of Perched Water Data from ICDF Monitoring Wells (Draft)" (see footnote b)
- *Analysis of Baseline Data from ICDF Detection Monitoring Wells* (Cahn, Meachum, and Leecaster 2003).

2.2.1 Subsurface Geology

The subsurface geology has been characterized through the drilling of numerous SRPA and perched water wells and coreholes located near the ICDF Complex and INTEC. Information on the subsurface has been gathered from logs (lithologic, geophysical, and video) as well as tests (geotechnical and hydrologic). Lithologic and geophysical logs for the wells near ICDF are included in Appendix A.

The subsurface beneath the ICDF Complex is characterized by approximately 30 to 55 ft of alluvial materials underlain by a series of basalt flows and discontinuous sedimentary interbeds, as shown on Figure 2-2. The surface alluvium at the ICDF Complex has been mapped as a flood delta or fan related to late Pleistocene cataclysmic flooding, most likely from the Pinedale Glaciation (Rathburn 1991). The Pinedale Glaciation occurred between 12,000 and 35,000 years ago. An intermittent layer of fine sand, silt, and clay known as "old alluvium" in the literature (designation SM to CL) ranges in thickness from 0 to 13 ft and occurs at the top of basalt. The thickness correlates to low spots and depressions and tends to increase to the south and west of the ICDF Complex. It is less prevalent in the northwest area. Sand lenses were periodically found within this layer. The sediments overlie vesicular dark gray, olivine basalt bedrock that may be weathered and fractured in the first several feet near the interface (DOE-ID 2000).

As can be seen in Figure 2-2, two very distinctive massive basalt flows can be used as marker beds and traced between most boreholes underneath the ICDF Complex. The depth at which these distinctive flows occur varies between boreholes. The CD basalt flow occurs at a depth between approximately 135 and 175 ft, and the DE5 basalt occurs at a depth between approximately 320 and 395 ft in USGS-57. The CD basalt flow is characterized by a higher-than-average natural-gamma count. Above the CD basalt flow is a fairly continuous series of thin interbeds interspersed with thin basalt flows. The DE5 basalt is among the thickest and most massive of the basalt flows found in the subsurface underlying the ICDF Complex and has a typical thickness of nearly 100 ft.

2.2.2 Hydrogeology

Surface water sources, perched water, and the underlying SRPA are summarized in the following subsections.

2.2.2.1 Surface Water Sources. The Big Lost River flows through Mackay Reservoir; past Arco, Idaho; and then turns northeast to its terminus on the INEEL in playas known as the Lost River Sinks. Water from the Big Lost River is diverted for irrigation and can be diverted into the INEEL spreading to areas upstream of INTEC. The Big Lost River is ephemeral on the INEEL. When it is flowing, it passes by the northwest corner of INTEC and is over 3,000 ft from the closest corner of the ICDF Complex.

2.2.2.2 Snake River Plain Aquifer. The SRPA underlies the ICDF Complex and is located about 450 ft below land surface. Groundwater in the SRPA generally occurs under unconfined conditions but locally may be semiconfined or artesian (Nace et al. 1959). Regional groundwater flow is generally south-southwest at average estimated velocities of 5 ft/day. The average groundwater velocity at the INTEC is estimated at 10 ft/day due to local hydraulic conditions. This information is from pumping tests (INEL 1995a and DOE-ID 1997a).

A small amount of recharge to the SPRA occurs directly from precipitation. Recharge to the SRPA within INEEL boundaries is primarily by underflow from the northeastern part of the plain and the Big Lost River. Recharge from the Big Lost River to the SRPA can be substantial downstream of Arco. Measured infiltration losses at various discharges ranges from 1 to 28 $ft^3/s/mi$ (Bennett 1990).

2.2.2.3 Perched Water. The following subsections provide a description of perched water found at INTEC.

2.2.2.3.1 Perched Water Formation and Dissipation—On the INEEL, perched water can only form in response to a source of surface water. As this water infiltrates downward through the alluvium and the underlying transmissive basalts, the water is impeded by lenses of low-permeability sediments and by low-permeability basalt flows, creating local areas of higher water saturation or moisture content. In some instances, enough water is present to form local perched water bodies. Perched water can form naturally at the base of the alluvium in response to rapid snowmelt or heavy precipitation events. Deeper zones of perched water in the interbeds can form near the Big Lost River when it is flowing. The water dissipates when the transient source of water stops. Year-round precipitation is insufficient to form continuous perched water—in part due to the low precipitation rates and the higher evapotranspiration rates. In order to form year-round perched water on the INEEL, a continuous source of surface water is necessary.

Percolation ponds have been the primary sources of recharge to perched water adjacent to the ICDF Complex. For a discussion of the perched water history, refer to the *ICDF Complex Groundwater Monitoring Plan* (DOE-ID 2002b). See footnote b for a discussion of perched water dissipation near the ICDF after use of the INTEC percolation was discontinued in August 2002.

2.2.3 Identification of Uppermost Aquifer

As stated in 40 CFR 264.97(a), "The groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths, to yield ground-water samples from the uppermost aquifer." According to the *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD)* (EPA 1986), the EPA has defined the uppermost aquifer as "the geologic formation…that is the aquifer nearest to the ground surface and is capable of yielding a significant

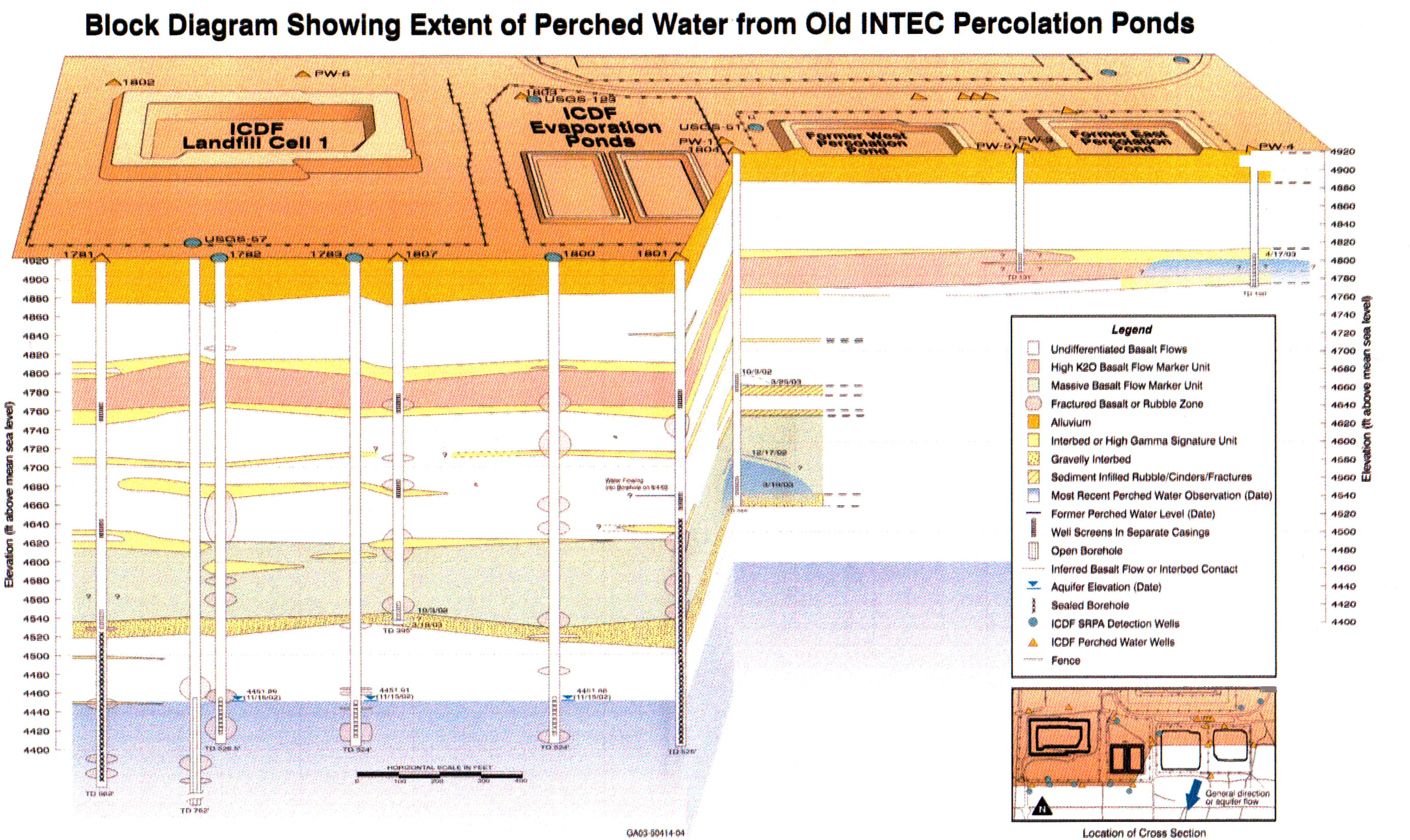

Figure 2-2. Geologic fence diagram through the ICDF.

amount of groundwater to wells or springs." The preceding sections of this Groundwater Monitoring Plan have demonstrated that the two perched water wells on the edge of the ICDF Complex (PW-1 and PW-6 have periodically gone dry. The *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD)* (EPA 1986) also states the following: "The owner/operator should have ensured and demonstrated that the upgradient and downgradient well screens intercepted the same uppermost aquifer" (Section 2.1.2, page 52).

The percolation ponds received hazardous waste after July 26, 1986, and, as a regulated unit, the soils underwent RCRA closure. The perched water near the ICDF Complex has been shown in the preceding sections to be affected by leakage from the percolation ponds.

The above discussions have demonstrated that the formation of perched water at the ICDF Complex is linked both physically and chemically to leakage from wastewater discharge to the percolation ponds. In addition, it is evident that the perched water began draining once use of the percolation ponds was discontinued in August 2003 and it is expected that the perched water, which occurs in only one ICDF well, will dissipate. The perched water will be monitored (where found) to provide early detection of leakage from the ICDF Complex. Once a perched-water well goes dry, it will not be deepened or replaced.

Because of the preexisting contamination in the perched water from the percolation ponds and contamination from the upgradient injection well in the aquifer, the ability to distinguish between contamination from other sources and leakage from the ICDF Complex will be critical. Other data, such as leachate concentration from the primary and secondary leak detection and recovery systems, as well as concentrations in other Group 4 and 5 wells, will be used as lines of evidence in determining whether the ICDF Complex has leaked.

2.2.4 Identification of Groundwater Flow Paths

The hydraulic gradient in the SRPA around INTEC is very flat. Flow is generally south-southwest. The best indicator for contaminant flow direction is existing plumes, particularly because there appears to be large lateral dispersion. Contour maps that show elevated I-129, H-3, Sr-90, Tc-99, gross beta, and chloride concentrations are shown in Figures 2-3 through 2-8. These figures show that groundwater has generally moved in a southwest direction from INTEC. The five downgradient detection-monitoring wells are located in the SRPA near the southern and southwestern edges of the ICDF Complex. Because the groundwater at the upgradient and downgradient monitoring wells is already contaminated with constituents similar to those that will be disposed of in the ICDF landfill and evaporation ponds, it will be critical to be able to distinguish between preexisting contamination (i.e., background water quality) in the SRPA and a leak from the ICDF. Data from leachate, primary and secondary leak detection and recovery systems, evaporation ponds, pump station, and other monitoring wells will be used as lines of evidence to determine if statistically significant evidence of contamination is from a leak from the ICDF or from a source other than the ICDF.

2.2.5 Contaminant Distribution and Transport

The SRPA is already contaminated because the ICDF Complex is located downgradient from the former INTEC injection well and the INTEC facility and adjacent to the former percolation ponds. As was shown in Figures 2-3 through 2-8, elevated concentrations of I-129, H-3, Sr-90, Tc-99, gross beta, and chloride extend beneath the ICDF Complex. It is critical that the baseline water quality in the SRPA near the ICDF Complex be established and documented as background for the ICDF Complex monitoring network. This will be done through a combination of historical data from the upgradient and adjacent wells and baseline sampling conducted under this plan. Changes to water quality in the downgradient

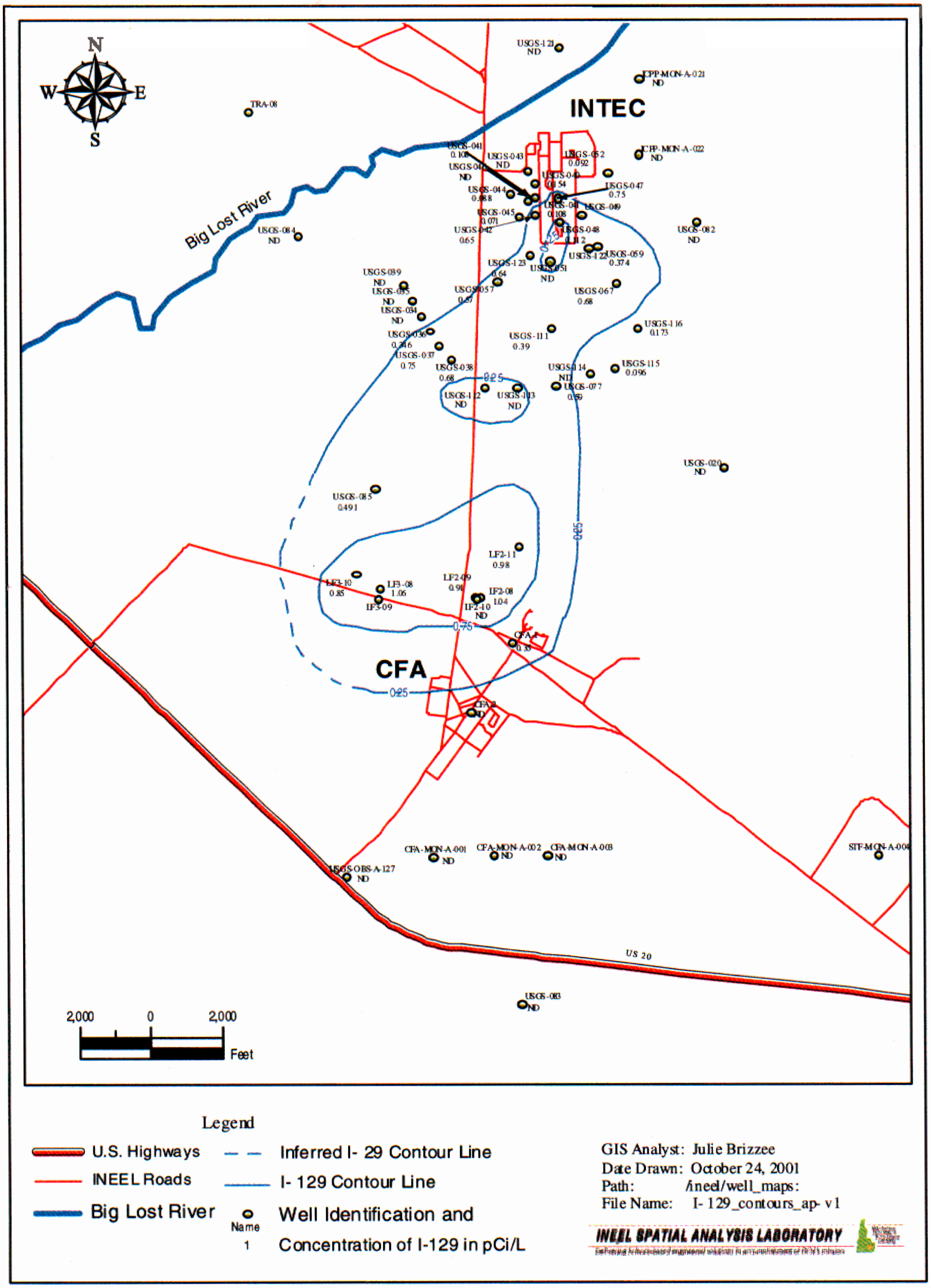

Figure 2-3. The I-129 concentrations in the Snake River Plain Aquifer in 2001.

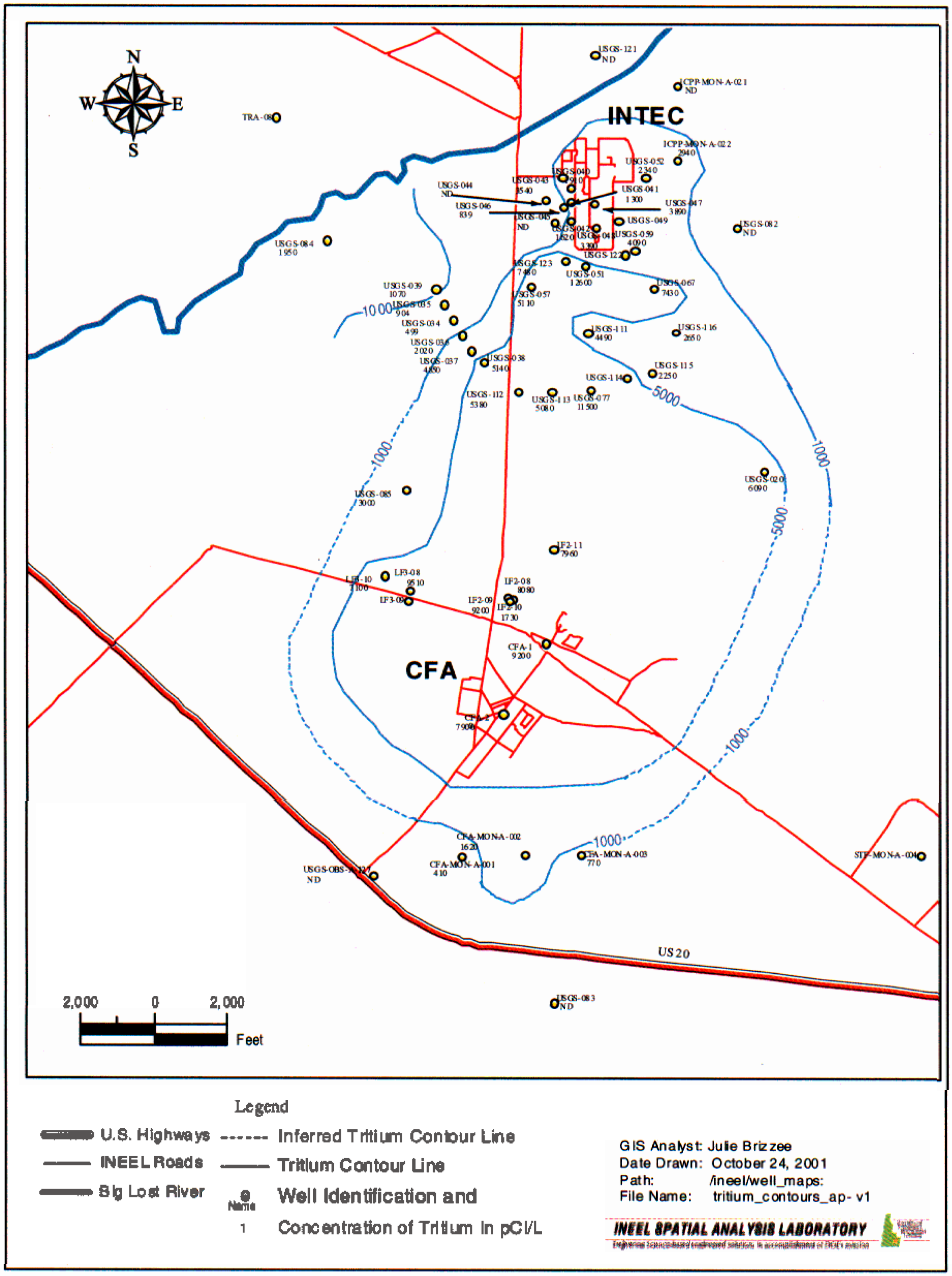

Figure 2-4. Tritium concentrations in the Snake River Plain Aquifer in 2001.

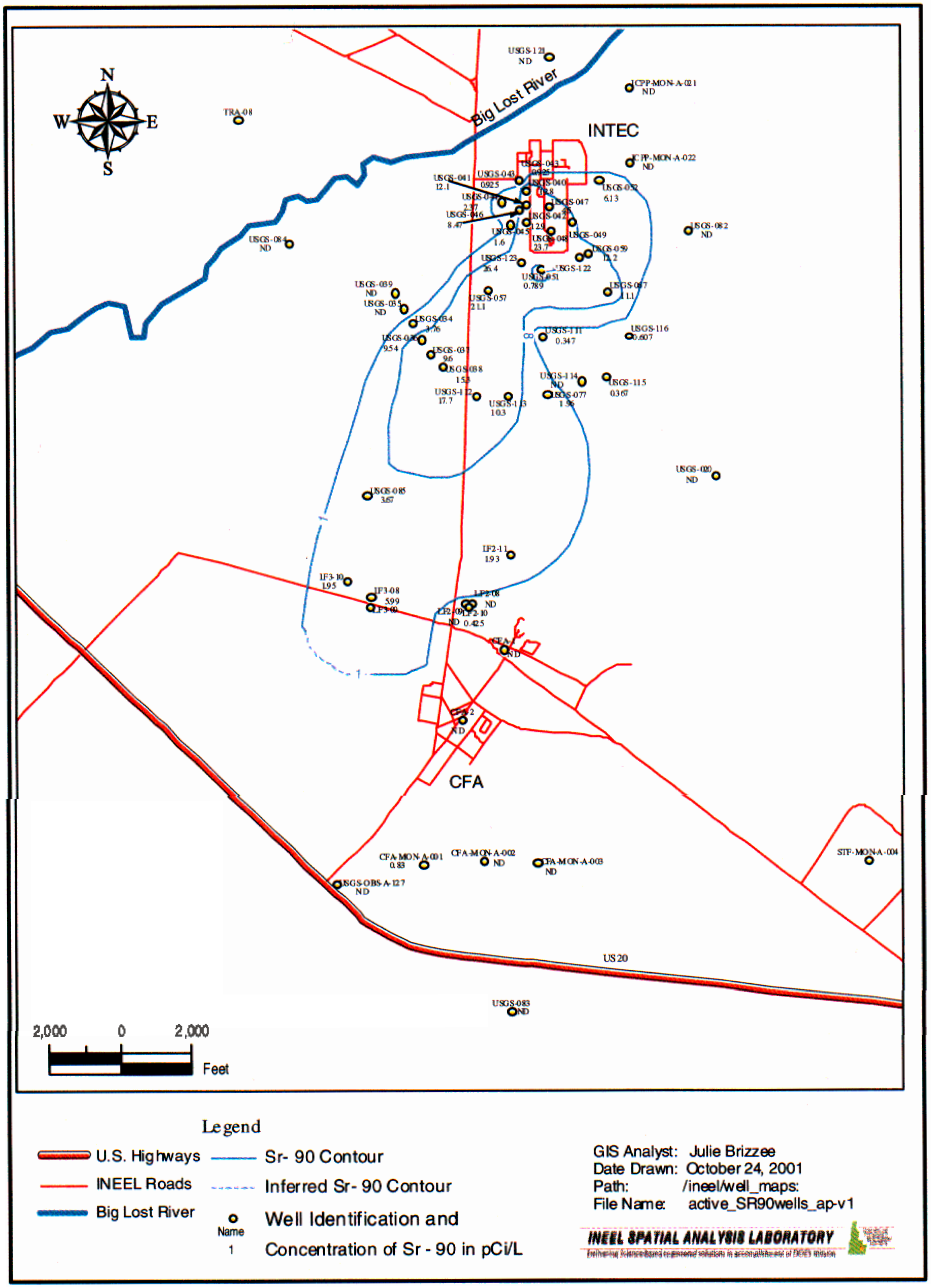

Figure 2-5. The Sr-90 plume in the Snake River Plain Aquifer in 2001.

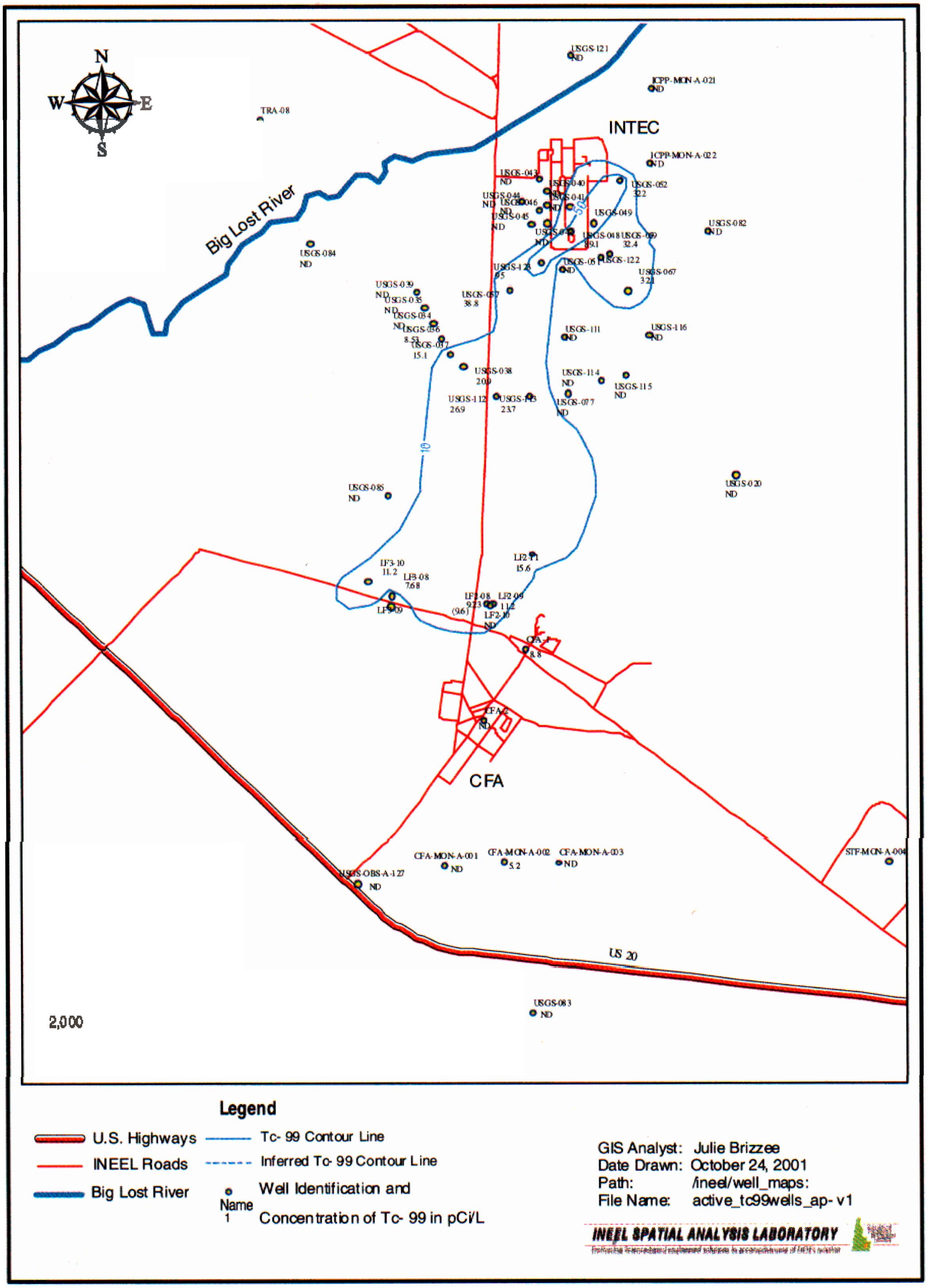

Figure 2-6. The Tc-99 concentrations in the Snake River Plain Aquifer in 2001.

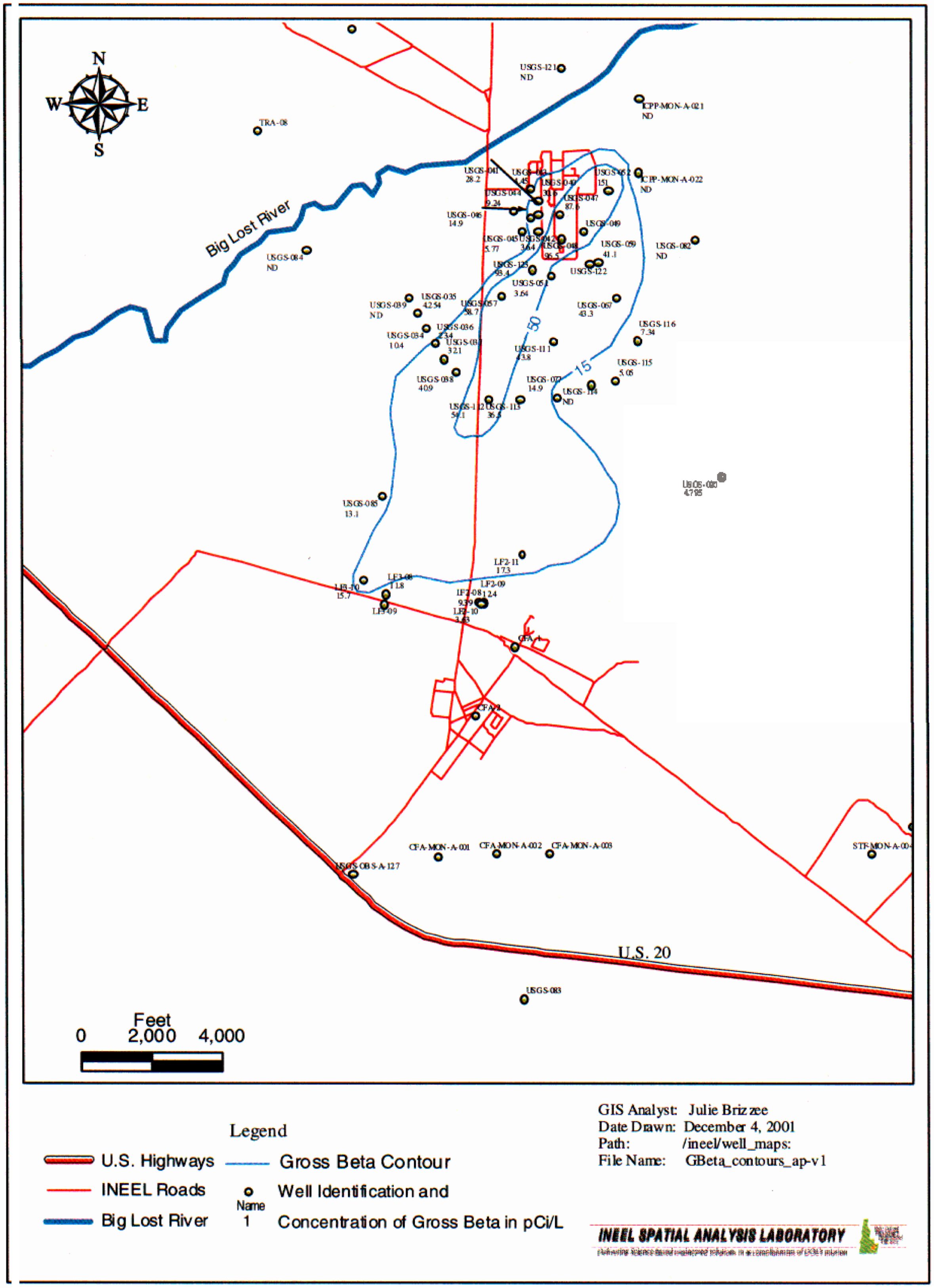

Figure 2-7. The gross beta plume in the Snake River Plain Aquifer in 2001.

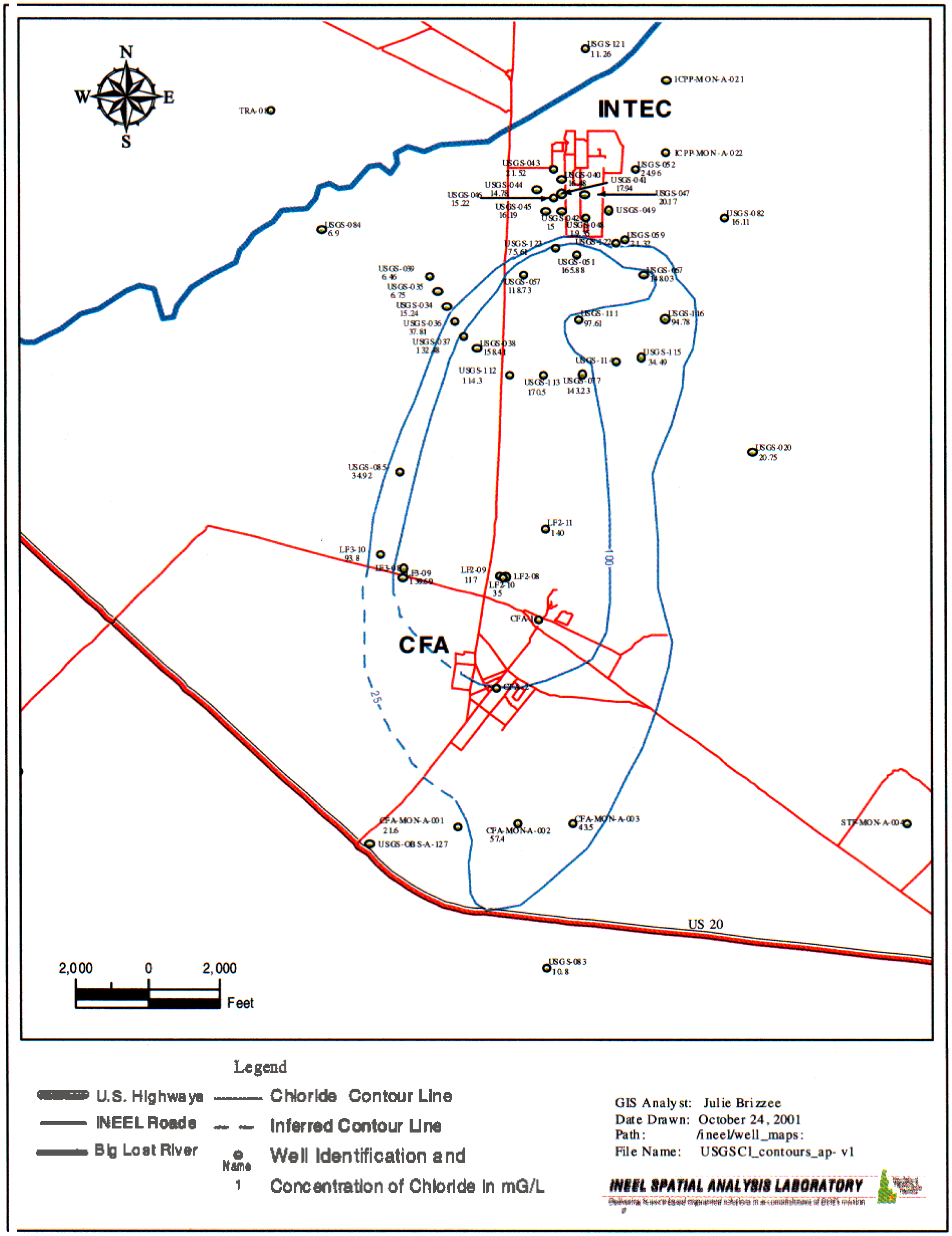

Figure 2-8. Chloride concentrations in the Snake River Plain Aquifer in 2001.

detection monitoring wells then can be compared with the upgradient wells to determine if there is a significant difference between the downgradient and upgradient water quality or significant changes in water quality in any one well.

The perched water and aquifer are already known to be contaminated from discharges to the former percolation ponds. The percolation ponds were taken out of service in August 2003.

In determining which contaminants to monitor as part of the ICDF Complex groundwater-monitoring program, it is helpful to examine predictions of travel times and concentrations of various contaminants. It is expected that contaminants will be detected initially at the leachate collection and recovery system located above the primary liner. Landfill leachate would next be expected to be found at the primary leak detection and recovery system located below the primary composite liner and above the secondary composite liner. If both liner systems fail, then landfill leachate will be removed from the secondary leak detection and recovery system located below both the primary and secondary composite liners. Nonretarded species would be expected to be discovered first in the leachate. For radioactive contaminants, half-life also is a factor in determining whether a contaminant will be detected and at what concentrations.

Monitoring of leak detection and recovery systems serves as an early warning if the ICDF liner systems are failing and can be used to verify or modify model predictions. Leachate is expected in all the leachate detection systems as pore water is squeezed out of the compacted clay liner under compression from the ICDF landfill. If contaminants of concern (COCs) are detected in the secondary leak detection and recovery system, the monitoring strategy can be altered as necessary.

Numerous fate and transport models have been used to predict future contaminant concentrations in the leachate and unsaturated zone pore water as well as transport times through the different layers to the SRPA.

The "Leachate Contaminant Reduction Time Study" (EDF-ER-274) predicts that over the 15-year operations period for the ICDF landfill, the "leachate will be a brackish to saline water dominated by sodium and sulfate and buffered by carbonates to a pH of around 8.2." Fate and transport modeling was conducted in EDF-ER, 275, "Fate and Transport Modeling Results and Summary Report," to predict potential concentrations in the SRPA over time from the ICDF landfill. The concentrations were predicted for a hypothetical SRPA monitoring well located 20 m downgradient from the ICDF Complex. Various infiltration rates were assumed to determine design requirements of the ICDF landfill. The modeling predicts that the ICDF Complex will be protective of the SRPA if it operates as designed, and detectable concentrations of radioactive contaminants from the complex are not expected in the secondary leak detection and recovery system for over 100 years. Predicted concentrations over time at the base of the compacted clay liner for several key contaminants are shown in Figure 2-9. For I-129 (iodine), the secondary leak detection and recovery system (SLDRS) concentrations are predicted to be below standard detection limits for the first 115 years. Standard detection limit, as used here, means a readily attainable detection limit that is around 10 times lower than the MCL or MCL equivalent. The MCL equivalent for I-129 is 1 pCi/L. For Np-237 (neptunium) and H-3 (tritium), the concentrations in the SLDRS are not predicted to ever go above standard detection limits. The MCL equivalent for Np-237 is 15 pCi/L, and the MCL for H-3 is 20,000 pCi/L. It is predicted that concentrations of Tc-99 in the SLDRS will only be detectable after 378 years, and Np-237 with Pu-241 and Am-241 will only be detectable after 2,460 years.

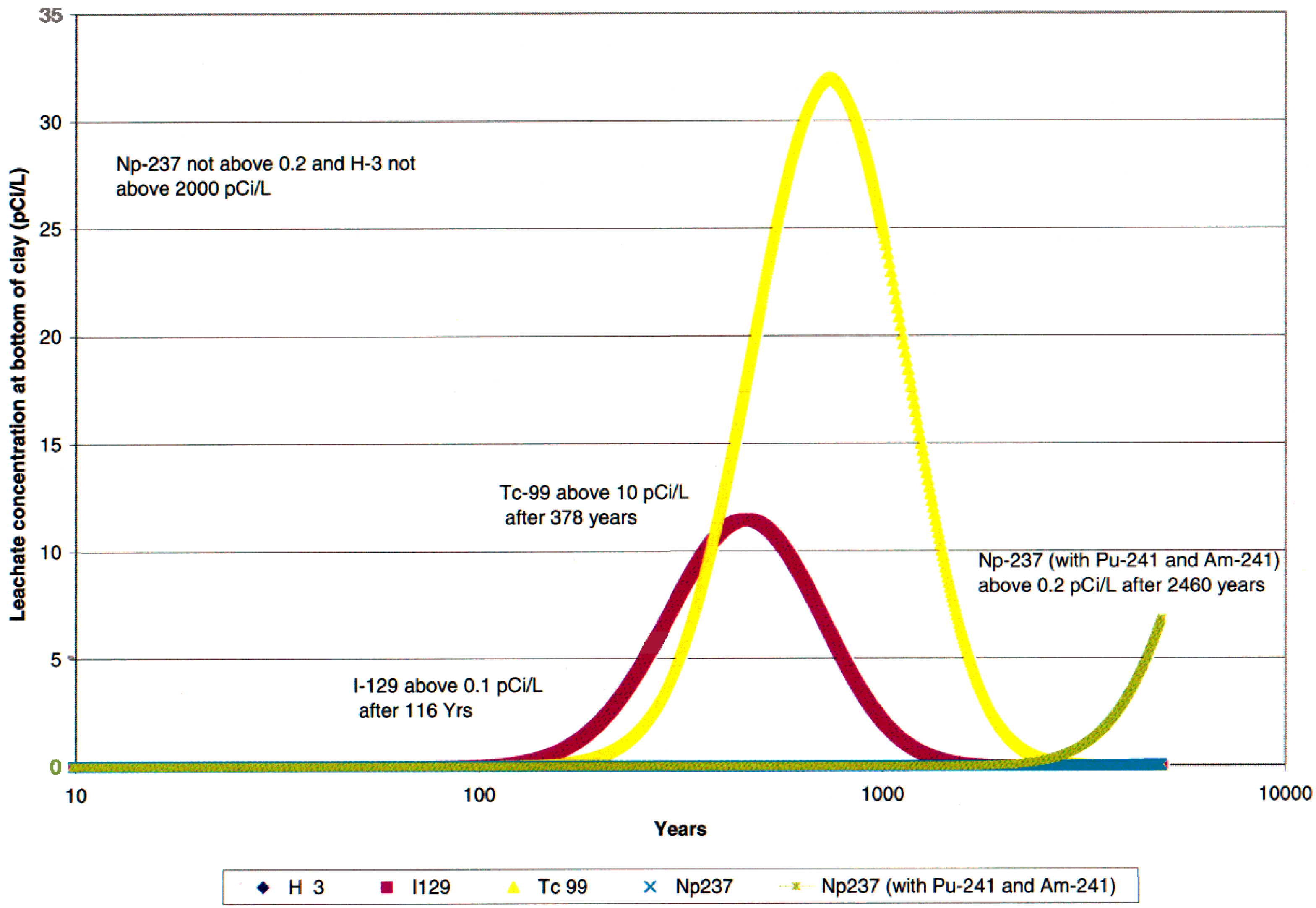

Figure 2-9. Predicted concentrations over time at the base of the compacted clay liner for several key contaminants.

In order to provide a simple estimate of upper bound contaminant arrival times, analytical calculations were performed to predict the arrival times for an advective front from the ICDF landfill for the most mobile contaminants assuming various infiltration rates. For the operations and clay layers, which are each 3 ft thick, the assumption of no cover over the waste and an infiltration rate of 0.0001 m/yr provides an upper bound on travel times. To be even more conservative, I-129 is assumed to have a soil-water distribution coefficient (K_d) of 0. Under this upper bound scenario, travel times through the operations and clay layers for the advective front would be 77 years for a nonretarded, nondecayed species such as I-129. For Tc-99, the travel time through the operations and clay layers would be 258 years. For Np-237, the travel time would be 9,469 years. Calculating travel times individually through each layer from the operations layer down to the first interbed and summing yields over 250 years for I-129, over 600 years for Tc-99, and over 16,500 years for Np-237. Summing upper bound travel times down to the SRPA yields 1,104 years for I-129, 2,076 years for Tc-99, and 42,173 years for Np-237. Actual travel times are expected to be orders of magnitude higher due to the presence of a cover, liners, and leachate removal, which drastically reduce the infiltration rates.

These modeling results and calculations show that if the ICDF landfill performs as it is designed, monitoring leachate and water quality in SRPA and perched water wells should demonstrate that the ICDF Complex is protective and is meeting the RAOs. The leachate monitoring systems are designed to indicate failure of the landfill at the earliest possible time so that appropriate steps can be taken to protect the SRPA.

2.3 Other Comprehensive Environmental Response, Compensation and Liability Act Site Actions

Currently, monitoring and remediation of the subsurface is being conducted for WAG 3 beneath INTEC and the ICDF Complex. These monitoring programs are designed based on the OU 3-13 ROD requirements and cover the perched water system (OU 3-13, Group 4) and the SRPA (OU 3-13, Group 5). More information on these programs can be found in the following documents:

- *Monitoring System and Installation Plan for Operable Unit 3-13, Group 4, Perched Water Well Installation* (DOE-ID 2003c)

- *Monitoring System and Implementation Plan for Operable Unit 3-13, Group 5, Snake River Plain Aquifer* (DOE-ID 2002a)

- *Geotechnical Report for the Conceptual Design of the INEEL CERCLA Disposal Facility at Waste Area Group 3, Operable Unit 3-13* (DOE-ID 2000).

3. DATA QUALITY OBJECTIVES

To help with defensible decision-making, the EPA has developed the Guidance *for the Data Quality Objective Process* (EPA 1994), which is a systematic planning tool, based on the scientific method, for establishing criteria for data quality and for developing data collection designs. Data quality objectives (DQOs) have been developed to guide monitoring and sampling at the ICDF Complex. The process consists of seven iterative steps that yield a set of principal study questions and decision statements that must be answered to address a primary problem statement. The seven steps comprising the DQO process are listed below:

- Step 1: State the problem
- Step 2: Identify the decision
- Step 3: Identify the inputs to the decision
- Step 4: Define the study boundaries
- Step 5: Develop decision rules
- Step 6: Specify limits on the decision
- Step 7: Optimize the design for obtaining data.

The DQOs that govern the ICDF Complex groundwater sampling and monitoring are presented in the following subsections. These objectives were negotiated with, and have the concurrence of, the Agencies. Additional information on the evaluation of data is provided in the *INEEL CERCLA Disposal Facility Groundwater Detection Program: Data Analysis Plan* (DOE-ID 2003).

3.1 State the Problem

In order to comply with ICDF Complex ARARs and WAG 3 RAOs, groundwater detection monitoring is required at the location of the new ICDF Complex. The ARARs require a detection-monitoring program to determine if a release has occurred from the ICDF landfills or evaporation pond into the uppermost aquifer or perched water that would result in exceeding the ICDF Complex RAOs for groundwater. The ICDF Complex RAOs require the NE-ID to prevent the release of leachate to underlying groundwater that would result in exceeding a cumulative carcinogenic risk of 1×10^{-4}, a total noncarcinogenic hazard index of 1, or applicable state and federal groundwater quality standards in the SRPA.

3.2 Identify the Decision

3.2.1 Principal Study Questions

The fundamental question to be addressed is shown below:

- Has operation of the ICDF landfill or evaporation pond resulted in the release of contaminants into the environment beneath the landfill that could exceed a cumulative carcinogenic risk of 1×10^{-4}, a total noncarcinogenic hazard index of 1, or applicable state and federal groundwater quality standards in the SRPA?

In order to answer this, the following questions will be studied:

- Is there evidence in the leachate or from the ICDF landfill or evaporation pond leak detection and recovery systems that could result in exceeding the RAOs in the SRPA?
- Are the downgradient SRPA wells significantly above preexisting contamination levels in the SRPA as a result of ICDF Complex operations?
- Do increases in perched water levels indicate a release from the ICDF Complex?
- If perched water levels are increasing, do increases in perched water concentrations indicate a potential for exceeding the RAOs in the SRPA?

3.2.2 Alternative Actions

The alternative actions associated with this monitoring program include determining that a significant release of contaminants has not occurred to the environment beneath the ICDF Complex or determining that a significant release has occurred and that corrective actions are required. A significant release means a release that could result in exceeding the RAOs in the SRPA. If any detection-monitoring well shows unexpected results above baseline conditions, the steps laid out in the *INEEL CERCLA Disposal Facility Groundwater Detection Monitoring Program: Data Analysis Plan* will be followed (DOE-ID 2003b). If re-sampling confirms the unexpected result(s), all lines of evidence (such as perched water levels, data from the ICDF Complex leachate collection sump and primary and secondary leak detection and recovery systems, artifacts of sampling or analysis, and Groups 4 and 5 data) will be considered in determining whether the ICDF Complex has leaked.

If the unexpected concentrations are due to a release from the ICDF, the substantive requirements of 40 CFR 264.99, "Compliance Monitoring Program," will be addressed. If the unexpected concentrations are due to a source other than the ICDF Complex or are due to decreased water levels in the perched water, detection monitoring will continue and the substantive requirements of 40 CFR 264.98(g)(6) will be addressed. The general methods that will be used to analyze the sample results are outlined in the *INEEL CERCLA Disposal Facility Groundwater Detection Monitoring Program: Data Analysis Plan* (DOE-ID 2003b). If statistically significant evidence of a release is detected in any downgradient SRPA groundwater-monitoring well, then re-sampling will occur to confirm the results. If the re-sampling and lines of evidence confirm that a significant release has occurred, then corrective measures will be implemented.

3.2.3 Consequences of Incorrect Alternative Actions

The analysis of data collected under this Groundwater Monitoring Plan is complicated, because preexisting contamination from other sources is present. Perched water contamination exists in near the ICDF Complex from the percolation ponds and potentially from other sources. The ICDF Complex is located downgradient from the former INTEC injection well, and known contamination exists in the SRPA under the ICDF Complex. Therefore, there are many reasons why statistically significant evidence of contamination that would be unrelated to ICDF Complex operations could occur in detection-monitoring wells. The two most likely scenarios are false positive results (Type 1 error) or a slug of contamination moving downgradient in the SRPA from the former injection well that has not passed the ICDF Complex yet.

The consequences of incorrectly concluding that the ICDF landfill or evaporation pond has leaked are severe. If remedial actions are taken on a sound landfill or evaporation pond, unnecessary expenses will be incurred to further investigate or attempt to remedy the problem and would include disposal delays that could affect other projects. The consequences of incorrectly concluding that there has not been a significant release to the environment from the ICDF Complex could result in further contamination of the perched water and, if the contamination were to reach the SRPA, additional contamination of the SRPA and exceeding the RAOs. Because the consequences of this are severe, the ICDF Complex and this Groundwater Monitoring Plan are being designed with multiple safety factors and monitoring points to make the likelihood of this happening extremely low. The design includes multiple layers in the cap, liners, leachate collection and detection systems, perched water monitoring points, and SRPA wells. In addition, multiple conservative assumptions have been used in all modeling efforts to predict ICDF Complex performance over time and set protective waste acceptance criteria and operating requirements.

3.2.4 Decision Statements

Detection monitoring data from the perched water and SRPA will be used along with lines of evidence to determine whether ICDF Complex waste disposal operations have resulted in a significant release of contaminants to the environment beneath the ICDF landfill or evaporation pond that would exceed RAOs in the SRPA. Should a significant release be identified through this monitoring program, corrective measures will be evaluated and implemented.

3.3 Identify Inputs to the Decision

The following information will be used to determine whether there is evidence that ICDF Complex operations have resulted in a release to the environment:

1. Collection and analysis of water samples from the unconsolidated sediments beneath the compacted clay layer (lowermost layer) of the ICDF landfill (secondary leak detection and recovery system).

2. Measurement of groundwater elevations near the ICDF Complex to determine the hydraulic gradient of the SRPA beneath the ICDF Complex.

3. Analysis of groundwater samples from the SRPA beneath the ICDF Complex, from monitoring wells upgradient of the ICDF landfill that represent background water quality, from downgradient of the ICDF landfill, and representing water quality passing the point of compliance.

4. Analysis of the SRPA sampling results for each indicator parameter comparing upgradient monitoring point concentrations to concentrations at downgradient monitoring wells to identify statistically significant evidence of elevated concentrations from the ICDF Complex landfill in the SRPA. Note: This evaluation will be performed in conjunction with the OU 3-13 Group 5 monitoring program and may include evaluation of other contaminant and data sources.

5. Analysis of samples from the ICDF landfill leachate collection system sump and primary and secondary leak detection and recovery systems and comparison to initial concentrations. Analytes found in the perched water and/or SRPA will be compared to those found in the landfill leachate. These data also will be used for periodic updates to the indicator compound analyte list.

6. Measurement of perched water levels to determine if they have increased.

7. Evaluation of OU 3-13 Group 4 monitoring data to determine if unusual perched water data at the ICDF Complex are a result of other sources.

8. Techniques to evaluate ICDF SRPA data that are outlined in the *INEEL CERCLA Disposal Facility Groundwater Detection Monitoring Program: Data Analysis Plan* (DOE-ID 2003b).

9. Analytical detection limits, which are discussed in Section 4.3.

10. Precision, accuracy, representativeness, comparability, and completeness, which are discussed in Section 7.1.

3.4 Define the Study Boundaries

This Groundwater Monitoring Plan includes detection monitoring in the SRPA and monitoring of water levels in both SRPA and perched water wells. The SRPA monitoring beneath the ICDF Complex will be conducted at points both upgradient and downgradient of the ICDF Complex boundary. As established in the ICDF Complex ARARs, the ICDF Complex groundwater-monitoring program is required to monitor the uppermost aquifer upgradient of the ICDF Complex to determine the background concentrations of hazardous constituents in groundwater. The groundwater-monitoring program also is required to collect groundwater samples representative of the quality of groundwater passing the point of compliance in the SRPA downgradient of the ICDF Complex.

Six new perched-water wells were installed around the ICDF with up to three completions in each borehole. All but one of these wells is dry. Water levels in ICPP-1804L are decreasing and it is expected to go dry over time, because the source was found to be the former percolation ponds. Perched water wells will not be drilled deeper or replaced. The Agencies have agreed that the isolated pockets of remnant perched water on the eastern edge of the ICDF will not be added to the existing detection monitoring network in the uppermost aquifer at this time. Perched water levels will be measured prior to routine SRPA sampling. If the trend in perched water levels changes, the perched water will be sampled during routine sampling if sufficient water exists, to determine the source of the water. Future data from these wells, when used with other lines of evidence such as leachate data, might detect a release from the ICDF. However, analysis of the data to determine if there is statistically significant evidence of contamination will be complicated or not possible on formerly dry wells because there may not be baseline data to compare with or the source of the water may not be comparable because it is from a different source (i.e., not from the former percolation ponds, which forms the baseline data set).

The groundwater-monitoring program will continue throughout the active life of the ICDF Complex and through the ICDF Complex closure period. The active life of the ICDF Complex is estimated to continue for 15 years from 2003 through 2018. The closure period for the ICDF Complex is estimated to continue 30 years past discontinuation of waste disposal at the ICDF Complex (through 2048). Monitoring of the ICDF landfill following the closure period will be conducted in coordination with the long-term monitoring of the broader INTEC facility and ROD requirements to ensure that RAOs are maintained in the SRPA beyond the year 2095.

3.5 Develop a Decision Rule

Under the regulatory requirements described in Section 1.2, this plan implements a detection-monitoring program for the ICDF Complex with the compliance point in the SRPA downgradient of the facility.

If detection monitoring indicates statistically significant evidence of contamination, then the requirements for Agency notification, reporting, and re-sampling set forth in the *INEEL CERCLA Disposal Facility Groundwater Detection Monitoring Program: Data Analysis Plan* will be followed (DOE-ID 2003b). If re-sampling confirms the unexpected result, then a determination will be made under

40 CFR 264.98(g) (6) using lines of evidence, whether the source is from the ICDF landfill or evaporation pond or another source. If the source is the ICDF Complex, then the substantive requirements of 40 CFR 264.99 will be met or corrective action will be initiated.

If it is determined through monitoring and lines of evidence that a release has occurred from the ICDF Complex, compliance monitoring will be implemented as set forth in Section 1.2. If sampling results or lines of evidence (such as contamination in the secondary leak detection and recovery system) indicate a significant release, corrective actions will be evaluated and implemented as necessary.

3.6 Specify the Tolerable Limits on Decision Errors

Evaluation of the ICDF Complex SRPA monitoring data will be performed to meet the substantive requirements of 40 CFR 264.97, as described in the *INEEL CERCLA Disposal Facility Groundwater Detection Monitoring Program: Data Analysis Plan* (DOE-ID 2003b) and the *Analysis of Baseline Data from ICDF Detection Monitoring Wells* (Cahn et al. 2003).

3.7 Optimize the Design

The NE-ID, the EPA, and the IDEQ have agreed to the design of the detection-monitoring system. It complies with the applicable substantive groundwater monitoring requirements of RCRA, 40 CFR 264, Subpart F. This detection-monitoring program requires four baseline samples from the SRPA wells prior to operation of the landfill.

Six SRPA wells will be monitored near the ICDF Complex, including one existing upgradient monitoring well and five new monitoring wells installed south of the ICDF Complex (see Figure 1-2). The existing monitoring well to be used for the ICDF Complex monitoring is USGS-123, located north of the ICDF Complex and between the ICDF Complex and the former INTEC injection well. Five new SRPA monitoring wells were constructed along the southern boundary of the ICDF Complex and are identified in Figure 1-2 as Wells ICPP-1782, ICPP-1783, ICPP-1800, ICPP-1829, and ICPP-1831. The new monitoring wells were installed downgradient of the ICDF Complex.

Six new perched water wells (ICPP-1781, ICPP-1801, ICPP-1802, ICPP-1803, ICPP-1804, and ICPP-1807) were installed at the locations shown in Figure 1-2. The wells were completed with a maximum of three completions. To monitor for possible influence of the Big Lost River located over 3,100 ft north of the ICDF Complex, transducers will be installed in ICPP-1802 and ICPP-1781 when the Big Lost River begins flowing. If the wells become saturated, they will be monitored until drain-out.

Water levels will be measured and the SRPA monitoring wells will be sampled to meet the requirements discussed in Section 1.2. This includes an initial baseline sampling of four independent samples. Following the baseline sampling, semiannual monitoring will be performed for the duration of the monitoring program unless sampling results indicate the need for corrective actions (as described in Section 1.2.3). In addition, samples will be collected once every 2-1/2 years and analyzed for a more extensive analyte list. The SRPA sampling schedule and analytes are summarized in Table 3-1. An additional four rounds of baseline samples will be collected from the downgradient monitoring wells due to Agency concerns that the water quality may change due to raising the pumps approximately 32 ft. Four samples will be analyzed from each well for C-14 to establish background water quality. The Agencies agreed that sampling would be increased to quarterly for indicator parameters for a year beginning June 2003. Because additional baseline sampling is being conducted for the downgradient monitoring wells, concurrent with indicator sampling, the Agencies agreed that duplicate analyses for indicator parameters would not be required. The wells and parameters that will be sampled during each sampling event through Fiscal Year 2008 are shown on Table 3-2. Sampling and analysis plan tables are included in Appendix B.

The analyte lists and sampling frequencies can be changed by agreement between the three Agencies based on evaluation of data and technical justifications. Water levels will be measured in the monitoring wells during each sampling event. Data from existing wells will be used to aid in understanding preexisting contamination.

In addition to detection monitoring in the SRPA, the *ICDF Complex Operational and Monitoring Sampling and Analysis Plan* (DOE-ID 2003a) includes leachate and leak detection and recovery system monitoring. The reasons for this are as follows:

1. It is important to be able to detect a release from the ICDF landfill at the earliest point. Leak detection monitoring serves this purpose.

2. Leachate monitoring will define the leachate contaminants and can be used as a line of evidence to support determination of whether increased concentrations are the result of a release from the ICDF landfill or evaporation pond or another source.

Table 3-1. Sampling schedule and analyte list for detection monitoring in the Snake River Plain Aquifer.

Sampling Period	Sampling Frequency	Analytes
Baseline	Four independent samples	Field parameters (pH, specific conductance, and temperature)
		Appendix IX VOCs and SVOCs
		Radionuclides (C-14; H-3; I-129; Tc-99; Sr-90; Pu-238, -239/240; U-234, -235, -238; and gamma spectroscopy)
		Appendix IX metals, filtered and unfiltered
		Major cations and anions (calcium, potassium, magnesium, sodium, nitrate, sulfate, bicarbonate, and chloride)
Post-baseline ICDF Complex operations	Semiannual	Field parameters (as above)
		Mercury and total chromium, field filtered
		Radionuclides (Sr-90 and Tc-99)
		Appendix IX VOCs
Years one and beyond of ICDF Complex operations	Every 2.5 years	In addition to the parameters above for semiannual:
		Appendix IX SVOCs
		Radionuclides (I-129; Pu-238, -239/-240; and U-234, -235, -238)
		Major cations and anions (as above)

ICDF = INEEL CERCLA Disposal Facility
SVOC = semivolatile organic compound
VOC = volatile organic compound

Table 3-2. Scheduled sampling events through Fiscal Year 2008.

	FY-03		FY-04					FY-05	FY-06		FY-07		FY-08	
	Jun-03	Sep-03	Dec-03	Mar-04	Jun-04	Sep-04	Dec-04	Jun-05	Dec-05	Jun-06	Dec-06	Jun-07	Dec-07	Jun-08
Baseline														
Upgradient	A													
Downgradient	#5			#6	#7	#8								
C-14			All wells	All wells	All wells	All wells								
Indicator														
Upgradient	included in baseline	X*	X	X	X		X	X	X	X	X	X	X	X
Downgradient	included in baseline	X*	X	included in baseline	included in baseline	included in baseline	X	X	X	X	X	X	X	X
Every 2.5 years														
All wells									X					X

A = Additional samples taken from baseline set for "equivalency" (not required and not full baseline set)
X* = filtered Hg and Cr missing

An evaluation of vadose zone monitoring techniques suitable for monitoring beneath the ICDF landfill was conducted to identify an optimum approach, given the objective for identifying the release of contaminants to the environment. The overriding technical advantage of installing a liner system for the collection of potential leachate releases from the ICDF landfill is the areal extent that the liner system is capable of integrating for sample collection. Using a liner system, the effective areal extent of sampling is dramatically increased. For this reason, an additional liner system for the interception and collection of leachate releases from the ICDF landfill was constructed. The additional liner system, or secondary leak detection and recovery system, was installed below the bottom compacted clay layer of the landfill. Sampling of the leachate collection system and leak detection systems is covered in the *ICDF Complex Operational and Monitoring Sampling and Analysis Plan* (DOE-ID 2003a).

4. MONITORING ACTIVITIES

The following sections describe the field activities and data collection to be used to meet the DQOs described in Section 3.

4.1 Sampling and Monitoring Locations

Table 4-1 lists the monitoring locations to be used for the ICDF Complex detection-monitoring program. These sampling locations also are shown in Figure 1-2.

Table 4-1. Locations of ICDF Complex detection-monitoring wells.

Well Name	Rationale for Well Location and Screen Interval
USGS-123	Upgradient well
ICPP-1831	Downgradient of ICDF landfill, uppermost permeable 40 ft of SRPA
ICPP-1782	Downgradient of ICDF landfill, uppermost permeable 40 ft of SRPA
ICPP-1783	Downgradient of ICDF landfill, uppermost permeable 40 ft of SRPA
ICPP-1800	Downgradient of ICDF evaporation pond, uppermost permeable 40 ft of SRPA
ICPP-1829	Downgradient of ICDF evaporation pond, uppermost permeable 40 ft of SRPA

ICDF = INEEL CERCLA Disposal Facility
ICPP = Idaho Chemical Processing Plant
SRPA = Snake River Plain Aquifer
USGS = U.S. Geological Survey

Water levels will be measured at all detection-monitoring wells and ICDF perched water wells shown on Figure 1-2 following the frequency in Table 3-1.

4.2 Schedule

The schedule for ICDF Complex groundwater monitoring is described in Table 3-1.

4.3 Data Types

The analytical methods and detection limits for each analyte and the required field quality control samples to be collected are described in the following subsections.

4.3.1 Analytical Methods

Monitoring samples will be analyzed for the list as outlined in Table 4-2. The analytes were based on an analysis of WAG 3 COCs, evaluation of the ICDF design inventory of waste to be disposed of (EDF-ER-264), predictive modeling of leachate generation, and K_ds. The list of analytes will be reviewed when validated results are received from sampling of the leachate collection system.

Table 4-2. ICDF Complex sampling analytes, methods, and detection limits.

Analyte	Analytical Method[a]	Detection Limits
Carbon-14	LSC	3 (baseline sampling) to 200 pCi/L
Tritium	LSC	400 pCi/L
Technetium-99	LSC or GFP	10 pCi/L
Iodine-129	LSS, LEPS, or GFP	0.1 (baseline sampling) to 1 pCi/L[b]
Strontium-90	GFP	1 pCi/L
Plutonium isotopes (Pu-238 and -239/240)	ALS	0.2 pCi/L
Uranium isotopes (U-234, -235, and –238)	ALS	0.2 pCi/L
Gamma spectroscopy	GMS	30 pCi/L
Appendix IX volatile organics	SW-846 Method 8260B	Varies by analyte
Appendix IX semivolatile organics	SW-846 Method 8270C	Varies by analyte
Appendix IX metals	SW-846 Methods 6010B, 7000A, 7062, 7471A, and 7742	Varies by analyte
Major cations	SW-846	Varies by analyte
Sulfate	SW-846 Method 9035, 9036, or 9038	Varies by analyte
Bicarbonate	Standard M Part 2320-B	Varies by analyte
Chloride	EPA Method 325.1, 325.2, or 325.3	Varies by analyte
Nitrate	EPA Method 353.2 (Revision 0), ASTM Standard D3876.90 (Method A or B), or Standard M Part 4500-NO3 (Method D, E, or F)	Varies by analyte

a. Methods used for radionuclide analysis are laboratory specific. The laboratory shall use standard operating procedures based on standard analytical methods provided to the INEEL Sample and Analysis Management Program (formerly called the Sample Management Office). The references that may be used to develop the laboratory standard operating procedures are in provided in the *Idaho National Engineering Laboratory Sample Management Office Statement of Work for Radionuclide Analysis* (Wells 1995).
b. Detection limit will depend on availability of water.
ALS = alpha spectrometry
ASTM = American Society for Testing and Materials
EPA = U.S. Environmental Protection Agency
GFP = gas flow proportional
GMS = gamma screen
LEPS low-energy photon spectrometry
LSC = liquid scintillation counting
LSS = liquid scintillation spectrometry

4.3.2 Field Quality Control

For groundwater monitoring and sampling, collection of quality control (QC) samples is required. Field quality requirements will be satisfied by collecting QC samples (duplicates, field blanks, trip blanks, equipment rinsates, and performance evaluation) during the groundwater sampling according to the schedule presented in Table 4-3.

Table 4-3. The quality assurance/quality control samples for groundwater sampling.

Activity	Type	Comment
Groundwater sampling	Duplicate	Field duplicates will be collected at a frequency of one per 20 samples per sampling event (baseline, semiannual).
	Field blanks	Field blanks will be collected at a frequency of one per 20 samples or one per 4 sampling days, whichever is more frequent. For less than 20 samples, one field blank will be collected. For 21–40 samples, two field blanks will collected.
	Trip blanks	Trip blanks will be collected when VOC samples are taken at a frequency of one per 20 samples per sampling event.
	Equipment rinsate	Equipment rinsate samples will be collected if the well does not have a dedicated pump. A minimum of one rinsate sample will be collected per 20 samples per sampling event.
	Performance evaluation sample	One performance evaluation sample will be collected per sampling event for each analyte except major ions during the sampling every 2.5 years. In addition, these will be collected during one of the four baseline sampling events.

VOC = volatile organic compound

4.4 Corrective Measures

In the event field personnel or auditors discover a discrepancy, some form of corrective measures will be initiated. The level of action taken is related to the level of the discrepancy. Corrective measures can range from field changes caused by unforeseen field conditions to DOE reportable incidents. Examples of corrective measures include re-sampling and/or reanalysis. Corrective action is described in Section 4.3.1 of the *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Inactive Sites* (DOE-ID 2002c).

5. SAMPLING PROCEDURES AND EQUIPMENT

This section describes the sampling and monitoring procedures and equipment to be used for the planned groundwater monitoring. In accordance with the FFA/CO (DOE-ID 1991), the Agencies will be notified at least 14 days before a planned sampling event. Before commencing any sampling activities, a prejob briefing will be held with all work-site personnel to review the requirements of the groundwater monitoring plan, the health and safety plan (HASP), and other work control documentation and to verify that all supporting documentation has been completed. After sampling, a postjob review will be conducted. All sampling will follow the current issues of technical procedures in *Environmental Monitoring Compliance/Monitoring Handbook* (Environmental Protection and Compliance Department 2004). Water levels will be measured, wells purged, and samples collected as described below.

5.1 Water Level Measurement

Water levels will be measured in each monitoring well during each groundwater-sampling event before well purging. All groundwater elevations will be measured using either an electronic measuring tape (Solinst brand or equivalent) or a steel tape measure. Measurement of all groundwater levels will be recorded to an accuracy of 0.01 ft.

5.2 Decontamination of Equipment

Before sampling, all nondedicated sampling equipment that comes in contact with the water sample will be decontaminated.

5.3 Well Purging

All wells will be purged before sample collection, and specific conductance, pH, and temperature will be measured.

5.3.1 Purge for Snake River Plain Aquifer Wells

For SRPA wells, low-flow purging or conventional technology may be used. The following steps will be followed:

- For low-flow purging, determine a purge rate that will minimize water-level changes and not redevelop the well. This rate should be about 1 gal/min, more or less, depending on well diameter and height of the water column. Maintain and measure (using an in-line flow meter or bucket and stopwatch) a constant purge rate.

- Purge a minimum of two to three times the calculated volume of the pump and discharge line (for low-flow purging) or the standing water column (for conventional purging) before sample collection. Using smaller-diameter purge lines will result in smaller purge volumes. This purge volume may differ by well within the monitoring network.

- For low-flow purging, ensure that the water level in each well remains constant (no draw down during low flow purging and sampling).

- Monitor field parameters using an in-line flow-through cell for analytical data collection needs. For low-flow purging, it is not necessary to use the readings as indicator parameters for stabilization.

- Avoid disturbance of the water column during low-flow purging and sampling.
- After the required purge volume has been extracted for the well, reduce the purging rate and collect the groundwater samples.
- Containerize and dispose of the generated purge water as directed by the project's waste management plan (see Section 10).

5.3.2 Bailer Purge for Perched Water Wells

Bailers will be used for purging and sampling perched water wells if a change in water level trend is observed. Because limited sample volumes are anticipated, parameters will not be required to stabilize before sampling. The well will either be purged dry or three well casing volumes will be purged, whichever occurs first. Purging will be considered complete, and samples will be collected. If insufficient water is available, the well will be allowed to recover for a minimum of 15 hours. If the volume is still insufficient, the samplers will collect the available water and sampling at the well will be considered complete.

5.4 Snake River Plain Aquifer and Perched Water Sampling

Groundwater samples will be collected for the analyses defined in Section 4. The requirements for containers, preservation methods, sample volumes, holding times, and analytical methods will be specified in the analytical laboratory statement of work and are summarized in Tables 5-1 through 5-3. The sampling and analysis plan (SAP) tables are provided in Appendix B.

If a change in water level trend is observed in a perched water well, the well will be sampled for information purposes to determine the source of the water. Perched water wells are not part of the detection-monitoring network at this time, and statistical analysis of the data might not be possible.

Samples for volatile organic compound (VOC) analysis require no headspace. All other bottles for groundwater samples will be filled to approximately 90 to 95% of capacity to allow for content expansion or preservation. Samples requiring acidification will be acidified to a pH <2 using ultra-pure nitric acid or sulfuric acid.

Samples for metals analysis during baseline sampling will be both unfiltered and filtered using a 0.45-µm in-line filter. If insufficient water is available, only one unfiltered water sample will be collected. To collect a filtered sample for metals analysis, a peristaltic pump will be used to pump the water through a 0.45-µm in-line filter directly into the sample bottle.

The following is the preferred order for measurements and sample collection when sample volume is limited (justifications are in parentheses):

1. Temperature, pH, and specific conductance during purging (routine, no extra volume required)
2. VOCs (limited sample volume required)
3. Radionuclides except I-129 (major COCs for ICDF Complex)
4. Metals, total chromium, mercury (chromium is an INEEL COC; mercury is the only metal that exceeds background in the design inventory).

Table 5-1. Baseline sampling analyte list, containers, and handling.

Matrix	Target Analyte List	Container: Size and Type	Container: Minimum Sample Quantity	Preservative	Holding Time
Water	Appendix IX VOCs	40 mL, GV	120 mL	Cool to 4°C, pH <2 with H_2SO_4, no headspace.	14 days
Water	Appendix IX SVOCs	1 L, AG	1 L	Cool to 4°C.	7 days
Water	Appendix IX metals	2 L, G or P	1,800 mL	HNO_3 to pH <2, filtered	180 days, except that mercury is 28 days
Water	Appendix IX metals	2 L, G or P	1,800 mL	HNO_3 to pH <2, unfiltered	180 days, except that mercury is 28 days
Water	Calcium, potassium, magnesium, sodium	2 L, G or P	1,500 mL	HNO_3 to pH <2, filtered	180 days
Water	Sulfate, bicarbonate (alkalinity)	l L, G or P	800 mL	Cool to 4°C.	28 days, except that alkalinity is 14 days
Water	Nitrate as N	125 mL, G or P	75 mL	H_2SO_4 to pH <2	28 days
Water	Chloride	250 mL, G or P	150 mL	None required	28 days
Water	U-234, -235, and -238; Pu-238 and -239/240; and gamma spec.	4 L, HDPE	4 L	HNO_3 to pH <2	6 months
Water	Sr-90	500 mL, HDPE	500 mL	HNO_3 to pH <2	6 months
Water	Tc-99	l L, HDPE	l L	HNO_3 to pH <2	6 months
Water	I-129 and tritium	8,500 mL, AG	1,100—8,500 mL depending on detection limit	None required	6 months
Water	C-14	500 mL, HDPE	300 mL	None required	6 months

A = amber
G = glass
HDPE = high-density polyethylene bottle
P = polyethylene
SVOC = semivolatile organic compound
V = vial
VOC = volatile organic compound

Table 5-2. Semiannual sampling analytes, containers, and handling.

Matrix	Target Analyte List	Container: Size and Type	Container: Minimum Sample Quantity	Preservative	Holding Time
Water	Appendix IX VOCs	40 mL, GV	120 mL	Cool to 4°C, pH <2 with H_2SO_4, no headspace.	14 days
Water	Mercury and total chromium	1 L, G or P	900 mL	HNO_3 to pH <2, filtered	180 days, except that mercury is 28 days
Water	Sr-90 and Tc-99	1,500 mL, HDPE	1,500 mL	HNO_3 to pH <2	6 months

G = glass
HDPE = high-density polyethylene bottle
P = polyethylene
V = vial
VOC = volatile organic compound

Table 5-3. Two-and-a-half year sampling analytes, containers, and handling.

Matrix	Target Analyte List	Container: Size and Type	Container: Minimum Sample Quantity	Preservative	Holding Time
Water	Appendix IX VOCs	40 mL, GV	120 mL	Cool to 4°C, pH <2 with H_2SO_4, no headspace.	14 days
Water	Appendix IX SVOCs	1 L, AG	1 L	Cool to 4°C.	7 days
Water	Total chromium and mercury	1 L, G or P	900 mL	HNO_3 to pH <2, filtered	180 days
Water	Calcium, potassium, magnesium, sodium	2 L, G or P	1,500 mL	HNO_3 to pH <2, filtered	28 days, except that alkalinity is 14 days
Water	Sulfate, bicarbonate (alkalinity)	1 L, G or P	800 mL	Cool to 4°C.	28 days
Water	Nitrate as N	125 mL, G or P	75 mL	H_2SO_4 to pH <2	28 days
Water	Chloride	250 mL, G or P	150 mL	None required	6 months
Water	U-234, -235, -238 and Pu-238, -239/240	4 L, HDPE	4 L	HNO_3 to pH <2	6 months
Water	Sr-90	500 mL, HDPE	500 mL	HNO_3 to pH <2	6 months
Water	Tc-99	1 L, HDPE	1 L	HNO_3 to pH <2	6 months
Water	I-129	8 L, AG	1 L	None required	6 months

A = amber
G = glass
HDPE = high-density polyethylene bottle
P = polyethylene
SVOC = semivolatile organic compound
V = vial
VOC = volatile organic compound

5. Semivolatile organic compounds (SVOCs) (not expected in the leachate, but this will verify)

6. Major cations and anions (for fingerprinting)

7. I-129 (due to large sample volume needed).

Following sampling, all nondedicated equipment that came in contact with the well water also will be decontaminated prior to storage.

5.5 Personal Protective Equipment

The personal protective equipment required for groundwater monitoring is in the *Health and Safety Plan for the INEEL CERCLA Disposal Facility Operations* (INEEL 2003, or current revision). All personal protective equipment will be characterized before disposal based on groundwater and field screening results, and a hazardous waste determination shall be made.

6. SAMPLING CONTROL

Strict sample control is required on this project. Sample control ensures that unique sample identifiers are used for separate samples. It also ensures that documentation of sample collection information is such that a sampling event may be reconstructed at a later date. The following subsections detail unique sample designation, sample handling (including shipping), and radiological screening of samples.

6.1 Sample Identification Code

A systematic 10-character identification (ID) code will be used to uniquely identify all samples. Uniqueness is required to prevent the same ID code from being assigned to more than one sample.

When the first three characters of the code are ICD, this indicates that the sample originated from ICDF Complex monitoring activities. The next three numbers designate the sequential sample number for the project. The seventh and eighth characters represent a two-character set (e.g., 01, 02) for designation of field duplicate samples. The last two characters refer to a particular analysis and bottle type.

In this example, a groundwater sample collected in support of the ICDF Complex monitoring might be designated as ICD09001R8, where (from left to right):

- ICD designates the sample as being collected for the ICDF Complex groundwater monitoring
- 090 designates the sequential sample number
- 01 designates the type of sample (01 = original, 02 = field duplicate)
- R8 designates tritium analysis.

A SAP table/database will be used to record all pertinent information (well designation, media, date) associated with each sample ID code.

6.2 Sample Designation

A SAP table format was developed to simplify the presentation of the sampling scheme for project personnel. The following subsections describe the information presented in the SAP table/database.

6.2.1 Sample Description Fields

The sample description fields contain information related to individual sample characteristics.

6.2.1.1 Sampling Activity. The sampling activity field contains the first six characters of the assigned sample number. The sample number in its entirety will be used to link information from other sources (e.g., field data and analytical data) to the information in the SAP table for data reporting, sample tracking, and completeness reporting. The analytical laboratory also will use the sample number to track and report analytical results.

6.2.1.2 Sample Type. Data in this field will be selected from the following:

REG	for a regular sample
QC	for a quality control sample.

6.2.1.3 Matrix. Data in this field will be selected from the following:

GROUNDWATER	for water collected from the groundwater wells or perched water
WATER	for other water samples (e.g., rinsates, field blanks, trip blanks).

6.2.1.4 Collection Type. Data in this field will be selected from the following:

GRAB	for grab
TBLK	for trip blanks
FBLK	for field blanks
RNST	for equipment rinsates
DUP	for duplicate samples.

6.2.1.5 Planned Date. This date, or event identifier, is related to the planned sample collection start date. In order to coincide with the spring thaw and rains, the semiannual sampling events are planned for June and December.

6.2.2 Sample Location Fields

This group of fields pinpoints the exact location for the sample in three-dimensional space, starting with the general AREA, narrowing the focus to an exact location geographically, and then specifying the DEPTH in the depth field.

6.2.2.1 Area. The AREA field identifies the general sample-collection area. This field should contain the standard identifier for the INEEL area being sampled. For this investigation, samples are being collected from INTEC; thus, the area identifier will be "ICDF."

6.2.2.2 Location. This field may contain geographical coordinates, x-y coordinates, building numbers, or other location-identifying details, as well as program-specific information such as a borehole or well number. Data in this field will normally be subordinated to the AREA. This information is included on the labels generated by the Sample and Analysis Management Program to aid sampling personnel.

6.2.2.3 Type of Location. The type of location field supplies descriptive information concerning the exact sample location. Information in this field may overlap that in the location field, but it is intended to add detail to the location. An example would be "groundwater well."

6.2.2.4 Depth. The DEPTH identified will correspond to the completion interval of the well measured in feet from land surface.

6.2.3 Analysis Types

Fields AT1 through AT20 indicate analysis types (Tc-99, Sr-90) and quantity requested. More information is provided at the bottom of the form to clearly identify each type.

6.3 Sample Handling

Analytical samples for laboratory analyses will be collected in precleaned containers and packaged according to American Society for Testing and Materials (ASTM) or EPA-recommended procedures. The field QC samples will be included to satisfy the quality assurance (QA)/QC requirements for the program as outlined in the *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Inactive Sites* (DOE-ID 2002c) and in Section 4. Qualified analytical laboratories (approved by the Sample and Analysis Management Program) will analyze the samples.

6.3.1 Sample Preservation and Chain of Custody

Water samples will be preserved according to requirements listed in the Quality Assurance Project Plan (DOE-ID 2002c) or equivalent. The chain-of-custody procedures will be followed in accordance with the requirements of the Quality Assurance Project Plan (DOE-ID 2002c) or equivalent. Sample containers will be stored in a secured area accessible only to the field team members.

6.3.2 Transportation of Samples

Samples will be shipped in accordance with the regulations issued by the U.S. Department of Transportation (DOT) (49 CFR 171 through 49 CFR 178) and EPA sample-handling, packaging, and shipping methods (40 CFR 262, "Standards Applicable to Generators of Hazardous Waste").

6.3.2.1 Custody Seals. Custody seals will be placed on all shipping containers in such a way as to ensure that tampering or unauthorized opening does not compromise sample integrity. Clear plastic tape will be placed over the seals to ensure that the seals are not damaged during shipment.

6.3.2.2 On-Site and Off-Site Shipping. An on-Site shipment is any transfer of material within the perimeter of the INEEL. Site-specific requirements for transporting samples within INEEL boundaries and those required by the shipping and receiving department will be followed. Shipment within the INEEL boundaries will conform to DOT requirements, as stated in 49 CFR 171–178. Off-Site shipment will conform to all applicable DOT requirements.

6.4 Radiological Screening

If necessary, a gamma-screening sample will be collected and submitted to the Radiation Measurements Laboratory located at TRA-620 for a 20-minute analysis before shipment off-Site. If it is determined that the contact readings on the samples exceed 200 mr/hr beta/gamma, the samples will be held for analysis in the INTEC Remote Analytical Laboratory.

7. QUALITY ASSURANCE AND QUALITY CONTROL

The Quality Assurance Project Plan was developed for INEEL WAGs 1, 2, 3, 4, 5, 6, 7, 10, and inactive sites (DOE-ID 2002c). This plan pertains to all environmental, geotechnical, geophysical, and radiological testing, analysis, and data review. This section details the field elements of the Quality Assurance Project Plan to support field operations during the groundwater sampling and monitoring.

7.1 Project Quality Objectives

The QA objectives specify the measurements that must be met to produce acceptable data for a project. The technical and statistical qualities of these measurements must be properly documented. Precision, accuracy, and completeness are quantitative parameters that must be specified for physical/chemical measurements. Comparability and representativeness are qualitative parameters.

The QA objectives for this project will be met through a combination of field and laboratory checks. Field QC checks will consist of collecting field duplicates, equipment blanks, and field blanks. Laboratory checks consist of initial and continuing calibration samples, laboratory control samples, matrix spikes, and matrix spike duplicates. Laboratory QA is detailed in the Quality Assurance Project Plan (DOE-ID 2002c) and is beyond the scope of this Groundwater Monitoring Plan.

7.1.1 Field Precision

Field precision is a measure of the variability not due to laboratory or analytical methods. The three types of field variability or heterogeneity are spatially within a data population, between individual samples, and within an individual sample. Although the heterogeneity between and within samples can be evaluated using duplicate samples, overall field precision will be calculated as the relative percent difference between two measurements or the relative standard deviation between three or more measurements. The relative percent difference or relative standard deviation will be calculated as indicated in the Quality Assurance Project Plan (DOE-ID 2002c), for duplicate samples, during the data validation process. The EPA established precision goals for inorganic Contract Laboratory Program methods (EPA 1993) and the Sample and Analysis Management Program established precision goals for radiological analyses. Duplicate samples to assess precision will be sampled, one immediately following the other, at a frequency of one duplicate for every 20 samples as shown in Table 4-3.

7.1.2 Field Accuracy

Sources of field inaccuracy are sampling preservation and handling, field contamination, and the sample matrix. The sampling locations and methods are designed to be representative or focused on specific objectives. Sampling accuracy may be assessed by evaluating the results of field, equipment rinsate, and/or trip blanks as described in Subsection 4.3.2.2 of the Quality Assurance Project Plan (DOE-ID 2002c). During the sampling for VOCs, some portion of the volatile components may be lost. Although EPA-approved methods will be used to minimize the loss, there is no easy way to measure that loss.

During sample collection or shipping, contamination of the samples by sources other than the contamination under investigation would yield incorrect analytical results. To assess the occurrence of any possible contamination, field blanks, trip blanks for VOCs, and rinsates (if equipment that comes in contact with the samples is shared between wells) will be collected to evaluate any potential impacts. One goal of the sampling program is to eliminate any cross-contamination associated with sample collection or shipping.

Accuracy of field instrumentation will be maintained by calibrating all instruments used to collect data and crosschecking with other independently collected data.

7.1.3 Quality Assurance Project Plan Representativeness

Representativeness is evaluated by assessing the accuracy and precision of the sampling program and expressing the degree to which samples represent actual site conditions. In essence, representativeness is a qualitative parameter that addresses whether the sampling program was properly designed to meet the DQOs. The representativeness criterion is best satisfied by confirming that sampling locations are selected properly and a sufficient number of samples are collected to meet the requirements stated in the DQOs (see Section 3).

7.1.4 Comparability

Comparability is a qualitative measure of the confidence with which one data set can be compared to another. These data sets include data generated by different laboratories performing this work, data generated by laboratories in previous studies, data generated by the same laboratory over a period of several years, or data obtained using different sampling techniques or analytical protocols. For field aspects of this program, data comparability will be achieved using standard methods of sample collection and handling. Data collection frequency and long-term trends will ensure comparability of monitoring data.

7.1.5 Completeness

Field completeness will be assessed by comparing the number of samples collected to the number of samples planned. Field sampling completeness is affected by such factors as equipment and instrument malfunctions and by insufficient sample recovery. Completeness can be assessed following data validation and reduction. The completeness goal for this project is 100% for critical activities.

During baseline sampling, obtaining samples from the SRPA wells is considered critical. During post-baseline sampling, the upgradient SRPA well is considered critical. It may not always be possible to sample the SRPA wells due to pump malfunctions. For any one sampling event, a completeness goal of 80% for the downgradient wells is acceptable. If a pump malfunctions, the field team leader (FTL) should contact the project manager so that the pump can be fixed before the next scheduled sampling round. On the next sampling round, any SRPA well that was not sampled on the previous round will be considered critical. Because of the potential for the perched water to be dry during any sampling event, these samples are considered to be noncritical, and no completeness goal is set. Collection of water level data from the SRPA are considered critical activities under this Groundwater Monitoring Plan.

7.2 Field Data Recording

The recording of field data is important to ensure that there have been no errors in sample labeling and documentation. This includes cross-referencing the SAP table with sample labels, logbooks, and chain-of-custody forms. Before sample shipment to the laboratory, field personnel will ensure that all field information is documented properly.

7.3 Data Validation

All laboratory-generated data will be validated to a minimum Level B with Tier 1 data packages requested, which allows data to be validated later to Level A if the need arises. Data validation will be performed in accordance with Guide (GDE) -7003, “Levels of Analytical Method Data Validation.”

Field-generated data (e.g., water levels and water temperature) will be validated through the use of properly calibrated instrumentation, by comparing and crosschecking data with independently gathered data, and by recording data-collection activities in a bound field logbook.

7.4 Quality Assurance Objectives for Measurement

The QA objectives are specifications that the monitoring and sampling measurements identified in the Quality Assurance Project Plan (DOE-ID 2002a) must meet to produce acceptable data for the project. The technical and statistical quality of these measurements must be documented properly. Precision, accuracy, method detection limits, and completeness must be specified for chemical measurements. Specific QA objectives are included in the Quality Assurance Project Plan (DOE-ID 2002a).

8. DATA MANAGEMENT/DATA ANALYSIS AND UNUSUAL OCCURRENCES

The Integrated Environmental Data Management System (IEDMS) will manage and maintain the analytical data that result from groundwater sampling. The Hydrogeologic Data Repository will supply long-term management of the field data. This section discusses the approach to managing the data, analysis of data, and suggested responses to unusual occurrences.

8.1 Data Management

The following discussion presents the various processes associated with managing the data collected as part of this Groundwater Monitoring Plan. Data management will follow guidelines specified in the following subsections.

8.1.1 Laboratory Analytical Data

Analytical data are managed and maintained in the IEDMS. The components that make up the IEDMS provide an efficient and accurate means of sample and data tracking.

The IEDMS performs sample tracking throughout all phases of a sampling project, beginning with the assignment of unique sample ID numbers using the SAP Application Program. The SAP application produces a SAP table, which contains a list of sample ID numbers, sample demographics (area, location, and depth), and the planned analyses. Once the SAP application database is finalized, it is used to automatically produce sample labels and tags (with or without barcode identification). In addition, sampling guidance forms can be produced for the field sampling team and provide information such as sampling location, requested analysis, container types, and preservative.

When the analytical data package or sample delivery group is received, it is logged into the IEDMS journaling system (an integrated subsystem of the sample tracking system), which tracks the sample delivery group from data receipt to the Integrated Environmental Data Management System. Cursory technical reviews on the data packages are performed to assess the completeness and technical compliance with respect to the project's analysis-specific task order statement of work or statement of work. Any deficiencies, re-submittal actions, and special instructions are transmitted to the validator on the validation release form. This form is sent to the validator with the data package (when required).

Errors in the data package are resolved among the Sample and Analysis Management Program chemist(s), the originating laboratory, and the IEDMS staff. The validator through the assignment of data validation flags ensures data validity. The validator generates a limitations and validation report, which gives detailed information on the assignment of data qualifier flags. Copies of each Form 1 accompany the limitations and validation report with the validator assigned data qualifier flags and any changes to the data results. The validated data results, along with the data qualifier flags, are entered into the IEDMS database. From this database, a summary table (i.e., result table) is generated. The result table summarizes the sample ID numbers, sample logistics, analytes, and results for each particular type of analysis (such as inorganic, radiological, organic) from the sampling effort. In addition, the field sample data from this database are uploaded to the Integrated Environmental Data Management System.

8.1.2 Field Data

Field data include all data that are nonchemical analytical data generated in support of this groundwater-monitoring plan. These data will be managed according to the requirements specified in the

Data Management Plan for the Idaho National Engineering Laboratory Environmental Restoration Program (INEL 1995b). Final field data will reside in the Hydrogeologic Data Repository for long-term management. The Hydrogeologic Data Repository will maintain hard copies of the data reports along with electronic copies of the final field data.

8.2 Data Analysis

The Sample and Analysis Management Program will validate and analyze the analytical data in accordance with the requirements in GDE-7003, "Levels of Analytical Method Data Validation," or equivalent. Field data will be analyzed using methods that are appropriate for the data types and specific field conditions. Some data sets may be filtered. Analysis will include recognized methods and techniques that are used with the specific data types and may include statistical processes.

8.3 Unusual Occurrences

Unusual occurrences are situations that are unforeseen, unanticipated, or unexpected. They may occur in chemical data sets or as field-related data and observations. An example of an unusual occurrence is detection of a COC where it was previously undetected.

The following is meant to provide a process for resolving an unusual occurrence rather than a method for dealing with each specific unusual occurrence. The following steps will be taken to resolve an unusual occurrence:

- Record the unusual occurrence and supporting observations in the field logbook.

- Validate the unusual occurrence (e.g., reanalyze the sample if any remains), and report to project manager as soon as possible.

- Determine if the occurrence is a one-time event or is recurring.

- If the unusual occurrence is of a significant nature (significant is anything that can potentially increase contaminant flux to the aquifer with concentration levels above MCLs, such as a large persistent increase in water levels), it will be reported to the appropriate project managers and EPA and IDEQ WAG managers.

- In the event that activities are creating an imminent or substantial endangerment to the health or welfare of workers or to the environment, work will stop immediately. In accordance with Section 29 of the FFA/CO (DOE-ID 1991), NE-ID will notify the EPA and IDEQ project managers within 24 hours and provide documentation no later than 10 working days after work stoppage.

- If the unusual occurrence is not of a significant nature (e.g., malfunctioning instrument that is reporting increases in water levels), it will be resolved by the technical leader and is not considered an issue.

- For significant unusual occurrences, take appropriate action, which may include re-sampling, increasing sampling (in network, not just an individual well) and/or monitoring frequency, or reviewing the ROD for implementation of a corrective action.

9. PROJECT ORGANIZATION AND RESPONSIBILITIES

This section describes the organization, roles, and responsibilities for the ICDF Complex groundwater monitoring activities. The following sections describe personnel responsibilities for ICDF groundwater monitoring activities. See Figure 9-1 for an organization chart for groundwater monitoring activities.

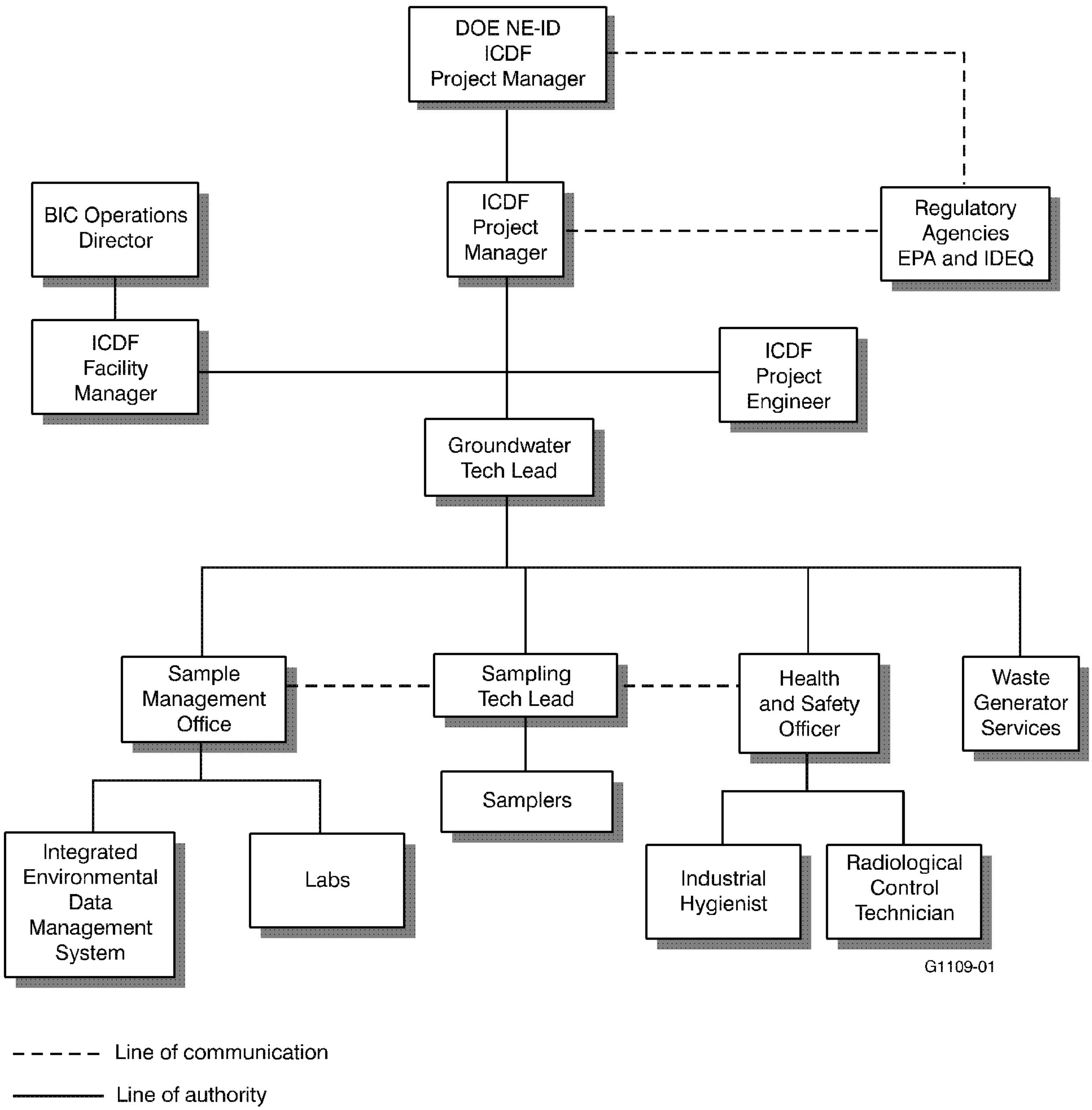

Figure 9-1. Groundwater monitoring activities organization chart.

9.1 U.S. Department of Energy Idaho Operations Office Project Manager

The NE-ID project manager is the owner's representative and is responsible for project funding and implementing the responsibilities identified in the FFA/CO (DOE-ID 1991). The NE-ID project manager will keep the regulatory Agencies informed of ICDF groundwater monitoring activities and progress.

9.2 Regulatory Agencies

The roles and responsibilities of the EPA and the IDEQ are defined in the FFA/CO (DOE-ID 1991). The NE-ID project manager will provide the Agencies with a 4-week schedule of field activities to be performed and will provide updates via conference calls every 2 weeks or more often as requested.

9.3 Balance of INEEL Cleanup Operations Director

The Balance of INEEL Cleanup (BIC) operations director has the authority and responsibility to ensure proper review of all activities within, and in support of, the ICDF for all work processes and packages. The BIC operations director is responsible for the overall operation of the ICDF. The ICDF project manager will keep the BIC operations director informed of ICDF monitoring activities from an upper-level management perspective.

The BIC director's authority includes, but is not limited to, the following:

- Establishing and executing monthly, weekly, and daily operating plans
- Executing the Environmental Safety and Health (ES&H)/QA program
- Executing the work planning for the BIC Project
- Executing the Voluntary Protection Program on the project
- Ensuring environmental compliance within the project
- Correcting the root cause functions of the accident investigation in the area.

9.4 Facility Manager for the ICDF

The facility manager for the ICDF reports directly to the BIC Operations director. The ICDF project manager will interface with the facility manager to ensure that ICDF monitoring activities are integrated smoothly and safely with ongoing ICDF activities and vice versa.

9.5 Balance of INEEL Cleanup Project Engineer

The BIC project engineer is responsible for providing technical support to the BIC project team. The ICDF project engineer supports the BIC project engineer in reviewing and/or preparing technical documents related to engineering design and analyses. The BIC project engineer reports to the BIC project director.

9.6 ICDF Project Manager

The ICDF project manager will have overall responsibility for the ICDF groundwater monitoring and will interface with the facility manager for the ICDF and the BIC project engineer. The ICDF project manager will direct the activities of the ICDF project and field team staff, including the ICDF project engineer, the ICDF health and safety officer (HSO), and the sample crew. In addition, the ICDF project manager functions as the point of contact for the ICDF operations subcontractor. Functionally, the ICDF project manager reviews and approves QA reports submitted by the ICDF QA certifying officer.

9.7 ICDF Project Engineer

The ICDF project engineer is responsible for reviewing technical documents related to ICDF groundwater monitoring. The ICDF project engineer reports to the ICDF project manager and supports the BIC project engineer.

9.8 ICDF Groundwater Technical Lead

The groundwater technical lead provides technical expertise and oversees implementation and revisions of the groundwater monitoring plan to ensure work is technically correct. The groundwater technical lead works with the ICDF project manager to ensure that:

- Site-specific plans, such as the groundwater monitoring plan and ES&H plans, required by the BIC Program incorporate groundwater monitoring scope
- Activities and deliverables meet schedule and scope requirements, as described in the FFA/CO Attachment A, "Action Plan for Implementation of the Federal Facility Agreement and Consent Order," (DOE-ID 1991) and applicable guidance
- Issues related to support of QA and ES&H for the project are resolved.

The groundwater technical lead will interface with the sampling technical lead and is responsible for coordinating with, and providing status to, the regulatory Agencies.

9.9 Sampling Technical Lead

The sampling technical lead is responsible for coordinating and overseeing the sampling and water level monitoring at the ICDF Complex. The sampling technical lead is responsible for ensuring that all samples are packaged properly and shipped to the appropriate laboratory and that all chain-of-custody forms are completed and recorded properly. In addition, the sampling technical lead is responsible for coordinating with necessary field personnel such as Waste Generator Services and Radiation Control personnel.

9.10 Samplers

The sampling team will perform the onsite tasks necessary to collect, package, and ship samples. Tasks may include the physical collection of sample material, completion of chain-of-custody and shipping request forms, and proper packaging of samples in accepted shipping containers (property labels and sealed coolers). The size and makeup of the sampling team will depend on the extent of the sampling task. The industrial hygienist and radiological control technician will support the sampling team when sampling is performed in contaminated wells, when deemed necessary by the industrial hygienist or the radiological control technician. The sampling team will be lead by the designated sample technical lead.

9.11 Health and Safety Officer

The HSO will be located at the work site and serves as the primary contact for health and safety issues. The HSO will assist the sampling technical lead on all aspects of health and safety (which includes complying with the work planning process) and is authorized to stop work at the work site if any operation threatens worker or public health and/or safety. The HSO may be assigned other responsibilities, as stated in other sections of the project HASP, as long as those responsibilities do not interfere with the primary responsibilities stated here. The HSO is authorized to verify compliance to the actions, as appropriate. Other ES&H professionals at the work site (industrial hygienist, radiological control technician, radiological engineer, environmental compliance coordinator, and facility representatives) may support the HSO, as necessary.

Persons assigned as the HSO, or alternate HSO, must be qualified (in accordance with the Occupation Safety and Health Administration definition) to recognize and evaluate hazards and will be given the authority to take or direct actions to ensure that workers are protected. While the HSO may also be the industrial hygienist at the work site (depending on the hazards, complexity, and size of the activity involved and with concurrence from the BIC ES&H/QA manager), other task-site responsibilities of the HSO must not conflict (philosophically or in terms of significant added volume of work) with the role of the HSO at the work site.

If it is necessary for the HSO to leave the work site, an alternate individual will be appointed by the HSO to fulfill this role. The identity of the acting HSO will be recorded in the FTL logbook, and work-site personnel will be notified.

9.12 Industrial Hygienist

The assigned industrial hygienist is the primary source for information regarding nonradiological hazardous and toxic agents at the task site. The industrial hygienist will assess the potential of worker exposure to hazardous agents according to the contractor's safety and health manual, management control procedures, and accepted industrial hygienist practices and protocol. By participating in work-site characterization, the industrial hygienist assesses and recommends appropriate hazard controls for the protection of work-site personnel; operates and maintains airborne sampling and monitoring equipment; and reviews for effectiveness, recommends, and assesses the use of personal protective equipment required in the project HASP (recommending changes as appropriate).

In the event of an evacuation, the industrial hygienist in conjunction with other recovery team members will assist in determining whether conditions exist for safe work-site reentry, as described in the project HASP. Personnel showing health effects (signs and symptoms) resulting from possible exposure to hazardous agents will be referred to an Occupational Medical Program physician by the industrial hygienist, the personnel's supervision, or the HSO. The industrial hygienist may have other duties at the work site, as specified in the project HASP, in the program requirements documents (PRDs), and/or management control procedures. During emergencies involving hazardous materials, airborne sampling and monitoring results will be coordinated with members of the Emergency Response Organization.

9.13 Radiological Control Technician

The assigned radiological control technician is the primary source for information and guidance on radiological hazards. The radiological control technician will be present at the job site during any work operations when personnel may be exposed to a radiological hazard. Responsibilities of the radiological control technician include radiological surveying of the work site, equipment, and samples; providing guidance for radiological decontamination of equipment and personnel; and accompanying the affected personnel to the nearest INEEL medical facility for evaluation if significant radiological contamination occurs. The radiological control technician will notify the FTL of any radiological occurrence that must be reported as directed by PRD-183, "INEEL Radiological Control Manual." The radiological control technician may have other duties at the job site, as specified in the project HASP, the program requirements document, and/or management control procedures.

9.14 Sample and Analysis Management Program

The INEEL Sample and Analysis Management Program has the responsibility of obtaining necessary laboratory services required to meet the needs of this project. Sample and Analysis Management Program personnel also will ensure that data generated from samples meet the needs of the project by validating all analytical laboratory data to resident protocol and ensuring that data are reported to the project in a timely fashion, as required by the FFA/CO (DOE-ID 1991).

The laboratory contracted by the Sample and Analysis Management Program will have overall responsibility for quality of the laboratory quality, control of laboratory costs, management of laboratory personnel, and adherence to agreed-upon laboratory schedules. Responsibilities of the laboratory personnel include preparing analytical reports, ensuring COC information is complete, and ensuring all QA/QC procedures are implemented in accordance with Sample and Analysis Management Program task order statements of work and master task agreements.

9.15 Waste Generator Services

Waste Generator Services personnel provide support to the project in the area of waste segregation, storage, and disposal. For this project, a Waste Generator Services engineer will be assigned to take care of all waste generated from the tasks conducted for this project

9.16 Environmental Compliance Coordinator

The assigned environmental compliance coordinator monitors and advises the project manager, the technical lead, and the FTL performing job-site activities on environmental issues and concerns by ensuring compliance with DOE orders, EPA regulations, and other regulations concerning the effect of work-site activities on the environment.

The environmental compliance coordinator provides support surveillance services for hazardous waste storage and transport and for surface water/storm water run-off control. The environmental compliance coordinator will assist the FTL in completing the job requirements checklist.

9.17 Integrated Environmental Data Management System

The IEDMS technical leader will interface with the project manager during the preparation of the SAP database. This individual also provides guidance on the appropriate number of field QC samples required by the Quality Assurance Project Plan (DOE-ID 2002c). The numbers used by the project are unique from all others assigned by IEDMS. The preparation of the plan database, along with completion of the Sample and Analysis Management Program request services form, initiates the sample and sample waste tracking activities performed by the Sample and Analysis Management Program.

10. WASTE MANAGEMENT

Remediation-derived waste generated during well replacement, development, and purging and sampling will be managed in accordance with the *ICDF Complex Operations Waste Management Plan* (DOE-ID 2003e).

11. HEALTH AND SAFETY

Groundwater monitoring well replacement, development, maintenance, purging, and sampling will be performed in accordance with the *Health and Safety Plan for INEEL CERCLA Disposal Facility Operations* (INEEL 2003 or current revision). Before commencing fieldwork, the FTL will contact the ICDF HSO and obtain a copy of the names of the current project points of contact and emergency notification names, phone numbers, and pagers. A current list will be maintained in the field.

12. DOCUMENT MANAGEMENT

Subsection 12.1 summarizes document management and sample control. Documentation includes field logbooks used to record field data and sampling procedures, chain-of-custody forms, and sample container labels. The analytical results from this field investigation will be documented in reports.

12.1 Documentation

The FTL will be responsible for controlling and maintaining all field documents and records and for verifying that all required documents to be submitted to the INEEL Sample and Analysis Management Program are maintained in good condition. All entries will be made in indelible black ink. Errors will be corrected by drawing a single line through the error and entering the correct information. All corrections will be initialed and dated.

12.1.1 Sample Container Labels

Waterproof, gummed labels generated from the SAP database will display information such as the unique sample ID number, the name of the project, sample location, and analysis type. Labels will be completed and placed on the containers in the field before collecting the sample. Sample team members will provide information necessary for label completion. Such information may include sample date, time, preservative used, field measurements of hazards, and the sampler's initials.

12.1.2 Field Guidance Form

Field guidance forms, provided for each sample location, will be generated from the SAP database to ensure unique sample numbers. These forms are used to facilitate sample container documentation and organization of field activities. The forms contain information regarding the following:

- Media
- Sample ID numbers
- Sample location
- Aliquot ID
- Analysis type
- Container size and type
- Sample preservation.

12.1.3 Field Logbooks

In accordance with the INEEL Sample and Analysis Management Program format, field logbooks will be used to record information necessary to interpret the analytical data. All field logbooks will be controlled and managed according to company procedures.

12.1.3.1 Sample/Shipping Logbook. The field teams will use sample logbooks. Each sample logbook will contain information, such as:

- Physical measurements (if applicable)
- All QC samples
- Shipping information (e.g., collection dates, shipping dates, cooler ID number, destination, chain-of-custody number, name of shipper)
- All team activities
- Problems encountered
- Visitor log
- List of site contacts.

This logbook will be signed and dated at the end of each day's sampling activities.

12.1.3.2 Field instruments Calibration/Standardization Logbook. A logbook containing records of calibration data will be maintained for each piece of equipment requiring periodic calibration or standardization. This logbook will contain log sheets to record the date, time, method of calibration, and instrument ID number.

12.1.3.3 Field Team Leader's Daily Logbook. A project logbook maintained by the FTL will contain a daily summary of the following:

- All field team activities
- Visitor log
- List of site contacts
- Problems encountered
- Any corrective actions taken as a result of field audits.

This logbook will be signed and dated at the end of each day's sampling activities.

13. REPORTING

Documentation of the quality-assured data or results of the monitoring program will be submitted to the Agencies as the data become available but no later than 120 days after collection.

14. REFERENCES

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